

## WHAT IS CLAIMED IS:

1. A method for ex vivo expansion of stem cells, comprising the steps of;

5

(a) culturing said stem cells with a selected growth medium comprising a human interleukin-3 mutant polypeptide of (SEQ ID NO:15);

10 wherein Xaa at position 17 is Ser, Lys, Gly, Asp, Met, Gln, or Arg;

Xaa at position 18 is Asn, His, Leu, Ile, Phe, Arg, or Gln;

Xaa at position 19 is Met, Phe, Ile, Arg, Gly, Ala, or Cys;

Xaa at position 20 is Ile, Cys, Gln, Glu, Arg, Pro, or Ala;

15 Xaa at position 21 is Asp, Phe, Lys, Arg, Ala, Gly, Glu, Gln, Asn, Thr, Ser or Val;

Xaa at position 22 is Glu, Trp, Pro, Ser, Ala, His, Asp, Asn, Gln, Leu, Val or Gly;

Xaa at position 23 is Ile, Val, Ala, Leu, Gly, Trp, Lys, Phe,

20 Ser, or Arg;

Xaa at position 24 is Ile, Gly, Val, Arg, Ser, Phe, or Leu;

Xaa at position 25 is Thr, His, Gly, Gln, Arg, Pro, or Ala;

Xaa at position 26 is His, Thr, Phe, Gly, Arg, Ala, or Trp;

Xaa at position 27 is Leu, Gly, Arg, Thr, Ser, or Ala;

25 Xaa at position 28 is Lys, Arg, Leu, Gln, Gly, Pro, Val or Trp;

Xaa at position 29 is Gln, Asn, Leu, Pro, Arg, or Val;

Xaa at position 30 is Pro, His, Thr, Gly, Asp, Gln, Ser, Leu, or Lys;

Xaa at position 31 is Pro, Asp, Gly, Ala, Arg, Leu, or Gln;

30 Xaa at position 32 is Leu, Val, Arg, Gln, Asn, Gly, Ala, or Glu;

Xaa at position 33 is Pro, Leu, Gln, Ala, Thr, or Glu;

Xaa at position 34 is Leu, Val, Gly, Ser, Lys, Glu, Gln, Thr, Arg, Ala, Phe, Ile or Met;

Xaa at position 35 is Leu, Ala, Gly, Asn, Pro, Gln, or Val;

35 Xaa at position 36 is Asp, Leu, or Val;

Xaa at position 37 is Phe, Ser, Pro, Trp, or Ile;

Xaa at position 38 is Asn, or Ala;

Xaa at position 40 is Leu, Trp, or Arg;

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- Xaa at position 41 is Asn, Cys, Arg, Leu, His, Met, or Pro;  
 Xaa at position 42 is Gly, Asp, Ser, Cys, Asn, Lys, Thr, Leu, Val,  
 Glu, Phe, Tyr, Ile, Met or Ala;  
 Xaa at position 43 is Glu, Asn, Tyr, Leu, Phe, Asp, Ala, Cys, Gln,  
 5 Arg, Thr, Gly or Ser;  
 Xaa at position 44 is Asp, Ser, Leu, Arg, Lys, Thr, Met, Trp, Glu,  
 Asn, Gln, Ala or Pro;  
 Xaa at position 45 is Gln, Pro, Phe, Val, Met, Leu, Thr, Lys, Trp,  
 Asp, Asn, Arg, Ser, Ala, Ile, Glu or His;  
 10 Xaa at position 46 is Asp, Phe, Ser, Thr, Cys, Glu, Asn, Gln, Lys,  
 His, Ala, Tyr, Ile, Val or Gly;  
 Xaa at position 47 is Ile, Gly, Val, Ser, Arg, Pro, or His;  
 Xaa at position 48 is Leu, Ser, Cys, Arg, Ile, His, Phe, Glu, Lys,  
 Thr, Ala, Met, Val or Asn;  
 15 Xaa at position 49 is Met, Arg, Ala, Gly, Pro, Asn, His, or Asp;  
 Xaa at position 50 is Glu, Leu, Thr, Asp, Tyr, Lys, Asn, Ser, Ala,  
 Ile, Val, His, Phe, Met or Gln;  
 Xaa at position 51 is Asn, Arg, Met, Pro, Ser, Thr, or His;  
 Xaa at position 52 is Asn, His, Arg, Leu, Gly, Ser, or Thr;  
 20 Xaa at position 53 is Leu, Thr, Ala, Gly, Glu, Pro, Lys, Ser, or  
 Met;  
 Xaa at position 54 is Arg, Asp, Ile, Ser, Val, Thr, Gln, Asn, Lys,  
 His, Ala or Leu;  
 Xaa at position 55 is Arg, Thr, Val, Ser, Leu, or Gly;  
 25 Xaa at position 56 is Pro, Gly, Cys, Ser, Gln, Glu, Arg, His,  
 Thr, Ala, Tyr, Phe, Leu, Val or Lys;  
 Xaa at position 57 is Asn or Gly;  
 Xaa at position 58 is Leu, Ser, Asp, Arg, Gln, Val, or Cys;  
 Xaa at position 59 is Glu, Tyr, His, Leu, Pro, or Arg;  
 30 Xaa at position 60 is Ala, Ser, Pro, Tyr, Asn, or Thr;  
 Xaa at position 61 is Phe, Asn, Glu, Pro, Lys, Arg, or Ser;  
 Xaa at position 62 is Asn, His, Val, Arg, Pro, Thr, Asp, or Ile;  
 Xaa at position 63 is Arg, Tyr, Trp, Lys, Ser, His, Pro, or Val;  
 Xaa at position 64 is Ala, Asn, Pro, Ser, or Lys;  
 35 Xaa at position 65 is Val, Thr, Pro, His, Leu, Phe, or Ser;  
 Xaa at position 66 is Lys, Ile, Arg, Val, Asn, Glu, or Ser;  
 Xaa at position 67 is Ser, Ala, Phe, Val, Gly, Asn, Ile, Pro, or  
 His;

- Xaa at position 68 is Leu, Val, Trp, Ser, Ile, Phe, Thr, or His;  
 Xaa at position 69 is Gln, Ala, Pro, Thr, Glu, Arg, Trp, Gly, or Leu;
- Xaa at position 70 is Asn, Leu, Val, Trp, Pro, or Ala;
- 5 Xaa at position 71 is Ala, Met, Leu, Pro, Arg, Glu, Thr, Gln, Trp, or Asn;
- Xaa at position 72 is Ser, Glu, Met, Ala, His, Asn, Arg, or Asp;  
 Xaa at position 73 is Ala, Glu, Asp, Leu, Ser, Gly, Thr, or Arg;  
 Xaa at position 74 is Ile, Met, Thr, Pro, Arg, Gly, Ala;
- 10 Xaa at position 75 is Glu, Lys, Gly, Asp, Pro, Trp, Arg, Ser, Gln, or Leu;
- Xaa at position 76 is Ser, Val, Ala, Asn, Trp, Glu, Pro, Gly, or Asp;
- Xaa at position 77 is Ile, Ser, Arg, Thr, or Leu;
- 15 Xaa at position 78 is Leu, Ala, Ser, Glu, Phe, Gly, or Arg;  
 Xaa at position 79 is Lys, Thr, Asn, Met, Arg, Ile, Gly, or Asp;
- Xaa at position 80 is Asn, Trp, Val, Gly, Thr, Leu, Glu, or Arg;  
 Xaa at position 81 is Leu, Gln, Gly, Ala, Trp, Arg, Val, or Lys;
- 20 Xaa at position 82 is Leu, Gln, Lys, Trp, Arg, Asp, Glu, Asn, His, Thr, Ser, Ala, Tyr, Phe, Ile, Met or Val;
- Xaa at position 83 is Pro, Ala, Thr, Trp, Arg, or Met;  
 Xaa at position 84 is Cys, Glu, Gly, Arg, Met, or Val;  
 Xaa at position 85 is Leu, Asn, Val, or Gln;
- 25 Xaa at position 86 is Pro, Cys, Arg, Ala, or Lys;  
 Xaa at position 87 is Leu, Ser, Trp, or Gly;  
 Xaa at position 88 is Ala, Lys, Arg, Val, or Trp;  
 Xaa at position 89 is Thr, Asp, Cys, Leu, Val, Glu, His, Asn, or Ser;
- 30 Xaa at position 90 is Ala, Pro, Ser, Thr, Gly, Asp, Ile, or Met;  
 Xaa at position 91 is Ala, Pro, Ser, Thr, Phe, Leu, Asp, or His;  
 Xaa at position 92 is Pro, Phe, Arg, Ser, Lys, His, Ala, Gly, Ile or Leu;
- Xaa at position 93 is Thr, Asp, Ser, Asn, Pro, Ala, Leu, or Arg;
- 35 Xaa at position 94 is Arg, Ile, Ser, Glu, Leu, Val, Gln, Lys, His, Ala, or Pro;
- Xaa at position 95 is His, Gln, Pro, Arg, Val, Leu, Gly, Thr, Asn, Lys, Ser, Ala, Trp, Phe, Ile, or Tyr;

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- Xaa at position 96 is Pro, Lys, Tyr, Gly, Ile, or Thr;  
 Xaa at position 97 is Ile, Val, Lys, Ala, or Asn;  
 Xaa at position 98 is His, Ile, Asn, Leu, Asp, Ala, Thr,  
     Glu, Gln, Ser, Phe, Met, Val, Lys, Arg, Tyr or Pro;
- 5 Xaa at position 99 is Ile, Leu, Arg, Asp, Val, Pro, Gln,  
     Gly, Ser, Phe, or His;  
 Xaa at position 100 is Lys, Tyr, Leu, His, Arg, Ile, Ser, Gln,  
     or Pro;
- Xaa at position 101 is Asp, Pro, Met, Lys, His, Thr, Val,  
 10 Tyr, Glu, Asn, Ser, Ala, Gly, Ile, Leu, or Gln;  
 Xaa at position 102 is Gly, Leu, Glu, Lys, Ser, Tyr, or Pro;  
 Xaa at position 103 is Asp, or Ser;  
 Xaa at position 104 is Trp, Val, Cys, Tyr, Thr, Met, Pro, Leu,  
     Gln, Lys, Ala, Phe, or Gly;
- 15 Xaa at position 105 is Asn, Pro, Ala, Phe, Ser, Trp, Gln, Tyr,  
     Leu, Lys, Ile, Asp, or His;  
 Xaa at position 106 is Glu, Ser, Ala, Lys, Thr, Ile, Gly, or Pro;  
 Xaa at position 108 is Arg, Lys, Asp, Leu, Thr, Ile, Gln, His, Ser,  
     Ala or Pro;
- 20 Xaa at position 109 is Arg, Thr, Pro, Glu, Tyr, Leu, Ser, or Gly;  
 Xaa at position 110 is Lys, Ala, Asn, Thr, Leu, Arg, Gln, His, Glu,  
     Ser, or Trp;  
 Xaa at position 111 is Leu, Ile, Arg, Asp, or Met;  
 Xaa at position 112 is Thr, Val, Gln, Tyr, Glu, His, Ser, or Phe;
- 25 Xaa at position 113 is Phe, Ser, Cys, His, Gly, Trp, Tyr, Asp,  
     Lys, Leu, Ile, Val or Asn;  
 Xaa at position 114 is Tyr, Cys, His, Ser, Trp, Arg, or Leu;  
 Xaa at position 115 is Leu, Asn, Val, Pro, Arg, Ala, His, Thr,  
     Trp, or Met;
- 30 Xaa at position 116 is Lys, Leu, Pro, Thr, Met, Asp, Val, Glu,  
     Arg, Trp, Ser, Asn, His, Ala, Tyr, Phe, Gln, or Ile;  
 Xaa at position 117 is Thr, Ser, Asn, Ile, Trp, Lys, or Pro;  
 Xaa at position 118 is Leu, Ser, Pro, Ala, Glu, Cys, Asp, or Tyr;  
 Xaa at position 119 is Glu, Ser, Lys, Pro, Leu, Thr, Tyr, or Arg;
- 35 Xaa at position 120 is Asn, Ala, Pro, Leu, His, Val, or Gln;  
 Xaa at position 121 is Ala, Ser, Ile, Asn, Pro, Lys, Asp, or  
     Gly;  
 Xaa at position 122 is Gln, Ser, Met, Trp, Arg, Phe, Pro, His,

Ile, Tyr, or Cys;

Xaa at position 123 is Ala, Met, Glu, His, Ser, Pro, Tyr, or Leu;

wherein from 4 to 44 of the amino acids designated by  
5 Xaa are different from the corresponding amino acids of  
native (1-133) human interleukin-3; wherein from 1 to  
14 amino acids can be deleted from the N-terminus  
and/or from 1 to 15 amino acids can be deleted from the  
C-terminus of said interleukin-3 mutant polypeptide;  
10 and said interleukin-3 mutant polypeptide can  
additionally be immediately preceded by Methionine<sup>-1</sup>,  
Alanine<sup>-1</sup> or Methionine<sup>-2</sup> Alanine<sup>-1</sup>; and

(b) harvesting said cultured stem cells.  
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2. A method for ex vivo expansion of stem cells,  
comprising the steps of;

(a) culturing said stem cells with a selected  
20 growth medium comprising a human interleukin-3 mutant  
polypeptide of [SEQ ID NO:19];

wherein

Xaa at position 3 is Ser, Lys, Gly, Asp, Met, Gln, or Arg;  
25 Xaa at position 4 is Asn, His, Leu, Ile, Phe, Arg, or Gln;  
Xaa at position 5 is Met, Phe, Ile, Arg, Gly, Ala, or Cys;  
Xaa at position 6 is Ile, Cys, Gln, Glu, Arg, Pro, or Ala;  
Xaa at position 7 is Asp, Phe, Lys, Arg, Ala, Gly, Glu, Gln, Asn,  
Thr, Ser or Val;  
30 Xaa at position 8 is Glu, Trp, Pro, Ser, Ala, His, Asp, Asn, Gln,  
Leu, Val, or Gly;  
Xaa at position 9 is Ile, Val, Ala, Leu, Gly, Trp, Lys, Phe,  
Ser, or Arg;  
Xaa at position 10 is Ile, Gly, Val, Arg, Ser, Phe, or Leu;  
35 Xaa at position 11 is Thr, His, Gly, Gln, Arg, Pro, or Ala;  
Xaa at position 12 is His, Thr, Phe, Gly, Arg, Ala, or Trp;  
Xaa at position 13 is Leu, Gly, Arg, Thr, Ser, or Ala;  
Xaa at position 14 is Lys, Arg, Leu, Gln, Gly, Pro, Val or Trp;

- Xaa at position 15 is Gln, Asn, Leu, Pro, Arg, or Val;  
 Xaa at position 16 is Pro, His, Thr, Gly, Asp, Gln, Ser, Leu, or Lys;
- Xaa at position 17 is Pro, Asp, Gly, Ala, Arg, Leu, or Gln;
- 5 Xaa at position 18 is Leu, Val, Arg, Gln, Asn, Gly, Ala, or Glu;  
 Xaa at position 19 is Pro, Leu, Gln, Ala, Thr, or Glu;  
 Xaa at position 20 is Leu, Val, Gly, Ser, Lys, Glu, Gln, Thr, Arg, Ala, Phe, Ile or Met;
- Xaa at position 21 is Leu, Ala, Gly, Asn, Pro, Gln, or Val;
- 10 Xaa at position 22 is Asp, Leu, or Val;  
 Xaa at position 23 is Phe, Ser, Pro, Trp, or Ile;  
 Xaa at position 24 is Asn, or Ala;  
 Xaa at position 26 is Leu, Trp, or Arg;  
 Xaa at position 27 is Asn, Cys, Arg, Leu, His, Met, Pro;
- 15 Xaa at position 28 is Gly, Asp, Ser, Cys, Ala, Lys, Asn, Thr, Leu, Val, Glu, Phe, Tyr, Ile or Met;  
 Xaa at position 29 is Glu, Asn, Tyr, Leu, Phe, Asp, Ala, Cys, Gln, Arg, Thr, Gly or Ser;
- Xaa at position 30 is Asp, Ser, Leu, Arg, Lys, Thr, Met, Trp, Glu, Asn, Gln, Ala or Pro;
- 20 Xaa at position 31 is Gln, Pro, Phe, Val, Met, Leu, Thr, Lys, Asp, Asn, Arg, Ser, Ala, Ile, Glu, His or Trp;  
 Xaa at position 32 is Asp, Phe, Ser, Thr, Cys, Glu, Asn, Gln, Lys, His, Ala, Tyr, Ile, Val or Gly;
- 25 Xaa at position 33 is Ile, Gly, Val, Ser, Arg, Pro, or His;  
 Xaa at position 34 is Leu, Ser, Cys, Arg, Ile, His, Phe, Glu, Lys, Thr, Ala, Met, Val or Asn;
- Xaa at position 35 is Met, Arg, Ala, Gly, Pro, Asn, His, or Asp;  
 Xaa at position 36 is Glu, Leu, Thr, Asp, Tyr, Lys, Asn, Ser, Ala, Ile, Val, His, Phe, Met or Gln;
- 30 Xaa at position 37 is Asn, Arg, Met, Pro, Ser, Thr, or His;  
 Xaa at position 38 is Asn, His, Arg, Leu, Gly, Ser, or Thr;  
 Xaa at position 39 is Leu, Thr, Ala, Gly, Glu, Pro, Lys, Ser, Met, or;
- 35 Xaa at position 40 is Arg, Asp, Ile, Ser, Val, Thr, Gln, Asn, Lys, His, Ala or Leu;  
 Xaa at position 41 is Arg, Thr, Val, Ser, Leu, or Gly;  
 Xaa at position 42 is Pro, Gly, Cys, Ser, Gln, Glu, Arg, His,

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- Thr, Ala, Tyr, Phe, Leu, Val or Lys;
- Xaa at position 43 is Asn or Gly;
- Xaa at position 44 is Leu, Ser, Asp, Arg, Gln, Val, or Cys;
- Xaa at position 45 is Glu, Tyr, His, Leu, Pro, or Arg;
- 5 Xaa at position 46 is Ala, Ser, Pro, Tyr, Asn, or Thr;
- Xaa at position 47 is Phe, Asn, Glu, Pro, Lys, Arg, or Ser;
- Xaa at position 48 is Asn, His, Val, Arg, Pro, Thr, Asp, or Ile;
- Xaa at position 49 is Arg, Tyr, Trp, Lys, Ser, His, Pro, or Val;
- Xaa at position 50 is Ala, Asn, Pro, Ser, or Lys;
- 10 Xaa at position 51 is Val, Thr, Pro, His, Leu, Phe, or Ser;
- Xaa at position 52 is Lys, Ile, Arg, Val, Asn, Glu, or Ser;
- Xaa at position 53 is Ser, Ala, Phe, Val, Gly, Asn, Ile, Pro, or His;
- Xaa at position 54 is Leu, Val, Trp, Ser, Ile, Phe, Thr, or His;
- 15 Xaa at position 55 is Gln, Ala, Pro, Thr, Glu, Arg, Trp, Gly, or Leu;
- Xaa at position 56 is Asn, Leu, Val, Trp, Pro, or Ala;
- Xaa at position 57 is Ala, Met, Leu, Pro, Arg, Glu, Thr, Gln, Trp, or Asn;
- 20 Xaa at position 58 is Ser, Glu, Met, Ala, His, Asn, Arg, or Asp;
- Xaa at position 59 is Ala, Glu, Asp, Leu, Ser, Gly, Thr, or Arg;
- Xaa at position 60 is Ile, Met, Thr, Pro, Arg, Gly, Ala;
- Xaa at position 61 is Glu, Lys, Gly, Asp, Pro, Trp, Arg, Ser, Gln, or Leu;
- 25 Xaa at position 62 is Ser, Val, Ala, Asn, Trp, Glu, Pro, Gly, or Asp;
- Xaa at position 63 is Ile, Ser, Arg, Thr, or Leu;
- Xaa at position 64 is Leu, Ala, Ser, Glu, Phe, Gly, or Arg;
- Xaa at position 65 is Lys, Thr, Gly, Asn, Met, Arg, Ile, or Asp;
- 30 Xaa at position 66 is Asn, Trp, Val, Gly, Thr, Leu, Glu, or Arg;
- Xaa at position 67 is Leu, Gln, Gly, Ala, Trp, Arg, Val, or Lys;
- Xaa at position 68 is Leu, Gln, Lys, Trp, Arg, Asp, Glu, Asn, His, Thr, Ser, Ala, Tyr, Phe, Ile, Met or Val;
- 35 Xaa at position 69 is Pro, Ala, Thr, Trp, Arg, or Met;
- Xaa at position 70 is Cys, Glu, Gly, Arg, Met, or Val;
- Xaa at position 71 is Leu, Asn, Val, or Gln;
- Xaa at position 72 is Pro, Cys, Arg, Ala, or Lys;

- Xaa at position 73 is Leu, Ser, Trp, or Gly;  
 Xaa at position 74 is Ala, Lys, Arg, Val, or Trp;  
 Xaa at position 75 is Thr, Asp, Cys, Leu, Val, Glu, His, Asn, or Ser;
- 5 Xaa at position 76 is Ala, Pro, Ser, Thr, Gly, Asp, Ile, or Met;  
 Xaa at position 77 is Ala, Pro, Ser, Thr, Phe, Leu, Asp, or His;  
 Xaa at position 78 is Pro, Phe, Arg, Ser, Lys, His, Ala, Gly, Ile or Leu;  
 Xaa at position 79 is Thr, Asp, Ser, Asn, Pro, Ala, Leu, or Arg;
- 10 Xaa at position 80 is Arg, Ile, Ser, Glu, Leu, Val, Gln, Lys, His, Ala or Pro;  
 Xaa at position 81 is His, Gln, Pro, Arg, Val, Leu, Gly, Thr, Asn, Lys, Ser, Ala, Trp, Phe, Ile or Tyr;  
 Xaa at position 82 is Pro, Lys, Tyr, Gly, Ile, or Thr;
- 15 Xaa at position 83 is Ile, Val, Lys, Ala, or Asn;  
 Xaa at position 84 is His, Ile, Asn, Leu, Asp, Ala, Thr, Glu, Gln, Ser, Phe, Met, Val, Lys, Arg, Tyr or Pro;  
 Xaa at position 85 is Ile, Leu, Arg, Asp, Val, Pro, Gln, Gly, Ser, Phe, or His;
- 20 Xaa at position 86 is Lys, Tyr, Leu, His, Arg, Ile, Ser, Gln, Pro;  
 Xaa at position 87 is Asp, Pro, Met, Lys, His, Thr, Val, Tyr, Glu, Asn, Ser, Ala, Gly, Ile, Leu or Gln;  
 Xaa at position 88 is Gly, Leu, Glu, Lys, Ser, Tyr, or Pro;
- 25 Xaa at position 89 is Asp, or Ser;  
 Xaa at position 90 is Trp, Val, Cys, Tyr, Thr, Met, Pro, Leu, Gln, Lys, Ala, Phe, or Gly;  
 Xaa at position 91 is Asn, Pro, Ala, Phe, Ser, Trp, Gln, Tyr, Leu, Lys, Ile, Asp, or His;
- 30 Xaa at position 92 is Glu, Ser, Ala, Lys, Thr, Ile, Gly, or Pro;  
 Xaa at position 94 is Arg, Lys, Asp, Leu, Thr, Ile, Gln, His, Ser, Ala, or Pro;  
 Xaa at position 95 is Arg, Thr, Pro, Glu, Tyr, Leu, Ser, or Gly;  
 Xaa at position 96 is Lys, Asn, Thr, Leu, Gln, Arg,
- 35 His, Glu, Ser, Ala or Trp;  
 Xaa at position 97 is Leu, Ile, Arg, Asp, or Met;  
 Xaa at position 98 is Thr, Val, Gln, Tyr, Glu, His, Ser, or Phe;  
 Xaa at position 99 is Phe, Ser, Cys, His, Gly, Trp, Tyr, Asp,



Lys, Leu, Ile, Val or Asn;

Xaa at position 100 is Tyr, Cys, His, Ser, Trp, Arg, or Leu;

Xaa at position 101 is Leu, Asn, Val, Pro, Arg, Ala, His, Thr,  
Trp, or Met;

5 Xaa at position 102 is Lys, Leu, Pro, Thr, Met, Asp, Val, Glu, Arg,  
Trp, Ser, Asn, His, Ala, Tyr, Phe, Gln, or Ile;

Xaa at position 103 is Thr, Ser, Asn, Ile, Trp, Lys, or Pro;

Xaa at position 104 is Leu, Ser, Pro, Ala, Glu, Cys, Asp, or Tyr;

Xaa at position 105 is Glu, Ser, Lys, Pro, Leu, Thr, Tyr, or Arg;

10 Xaa at position 106 is Asn, Ala, Pro, Leu, His, Val, or Gln;

Xaa at position 107 is Ala, Ser, Ile, Asn, Pro, Lys, Asp, or  
Gly;

Xaa at position 108 is Gln, Ser, Met, Trp, Arg, Phe, Pro, His,  
Ile, Tyr, or Cys;

15 Xaa at position 109 is Ala, Met, Glu, His, Ser, Pro, Tyr, or Leu;

wherein from 4 to 44 of the amino acids designated by  
Xaa are different from the corresponding amino acids of  
native (1-133) human interleukin-3; and said

20 interleukin-3 mutant polypeptide can additionally be  
immediately preceded by Methionine<sup>-1</sup>, Alanine<sup>-1</sup> or  
Methionine<sup>-2</sup> Alanine<sup>-1</sup>; and

(b) harvesting said cultured stem cells.

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3. A method for ex vivo expansion of stem cells,  
comprising the steps of;

(a) culturing said stem cells with a selected  
30 growth medium comprising a human interleukin-3 mutant  
polypeptide of (SEQ ID NO:129);

wherein m is 0 or 1; Xaa at position 18 is Asn or Ile;

Xaa at position 19 is Met, Ala or Ile; Xaa at position

35 20 is Ile, Pro or Leu; Xaa at position 23 is Ile, Ala  
or Leu; Xaa at position 25 is Thr or His; Xaa at  
position 29 is Gln, Arg, Val or Leu; Xaa at position 32  
is Leu, Ala, Asn or Arg; Xaa at position 34 is Leu or

Ser; Xaa at position 37 is Phe, Pro, or Ser; Xaa at position 38 is Asn or Ala; Xaa at position 42 is Gly, Ala, Ser, Asp or Asn; Xaa at position 45 is Gln, Val, or Met; Xaa at position 46 is Asp or Ser; Xaa at position 49 is Met, Ile, Leu or Asp; Xaa at position 50 is Glu or Asp; Xaa at position 51 is Asn Arg or Ser; Xaa at position 55 is Arg, Leu, or Thr; Xaa at position 56 is Pro or Ser; Xaa at position 59 is Glu or Leu; Xaa at position 60 is Ala or Ser; Xaa at position 62 is Asn, Val or Pro; Xaa at position 63 is Arg or His; Xaa at position 65 is Val or Ser; Xaa at position 67 is Ser, Asn, His or Gly; Xaa at position 69 is Gln or Glu; Xaa at position 73 is Ala or Gly; Xaa at position 76 is Ser, Ala or Pro; Xaa at position 79 is Lys, Arg or Ser; Xaa at position 82 is Leu, Glu, Val or Trp; Xaa at position 85 is Leu or Val; Xaa at position 87 is Leu, Ser, or Trp; Xaa at position 88 is Ala or Trp; Xaa at position 91 is Ala or Pro; Xaa at position 93 is Pro or Ser; Xaa at position 95 is His or Thr; Xaa at position 98 is His, Ile, or Thr; Xaa at position 100 is Lys or Arg; Xaa at position 101 is Asp, Ala or Met; Xaa at position 105 is Asn or Gln; Xaa at position 109 is Arg, Glu or Leu; Xaa at position 112 is Thr or Gln; Xaa at position 116 is Lys, Val, Trp or Ser; Xaa at position 117 is Thr or Ser; Xaa at position 120 is Asn, Gln, or His; Xaa at position 123 is Ala or Glu; with the proviso that from four to forty-four of the amino acids designated by Xaa are different from the corresponding amino acids of native human interleukin-3; and

(b) harvesting said cultured stem cells.

4. A method for ex vivo expansion of stem cells, comprising the steps of; (a) culturing said stem cells with a selected growth medium comprising a human interleukin-3 mutant polypeptide of (SEQ ID NO:130);

wherein m is 0 or 1; n is 0 or 1; p is 0 or 1; Xaa at position 4 is Asn or Ile; Xaa at position 5 is Met, Ala

or Ile; Xaa at position 6 is Ile, Pro or Leu; Xaa at position 9 is Ile, Ala or Leu; Xaa at position 11 is Thr or His; Xaa at position 15 is Gln, Arg, Val or Leu; Xaa at position 18 is Leu, Ala, Asn or Arg; Xaa at position 20 is Leu or Ser; Xaa at position 23 is Phe, Pro, or Ser; Xaa at position 24 is Asn or Ala; Xaa at position 28 is Gly, Ala, Ser, Asp or Asn; Xaa at position 31 is Gln, Val, or Met; Xaa at position 32 is Asp or Ser; Xaa at position 35 is Met, Ile, Leu or Asp; Xaa at position 36 is Glu or Asp; Xaa at position 37 is Asn, Arg or Ser; Xaa at position 41 is Arg, Leu, or Thr; Xaa at position 42 is Pro or Ser; Xaa at position 45 is Glu or Leu; Xaa at position 46 is Ala or Ser; Xaa at position 48 is Asn, Val or Pro; Xaa at position 49 is Arg or His; Xaa at position 51 is Val or Ser; Xaa at position 53 is Ser, Asn, His or Gly; Xaa at position 55 is Gln or Glu; Xaa at position 59 is Ala or Gly; Xaa at position 62 is Ser, Ala or Pro; Xaa at position 65 is Lys, Arg or Ser; Xaa at position 67 is Leu, Glu, or Val; Xaa at position 68 is Leu, Glu, Val or Trp; Xaa at position 71 is Leu or Val; Xaa at position 73 is Leu, Ser or Trp; Xaa at position 74 is Ala or Trp; Xaa at position 77 is Ala or Pro; Xaa at position 79 is Pro or Ser; Xaa at position 81 is His or Thr; Xaa at position 84 is His, Ile, or Thr; Xaa at position 86 is Lys or Arg; Xaa at position 87 is Asp, Ala or Met; Xaa at position 91 is Asn or Gln; Xaa at position 95 is Arg, Glu, Leu; Xaa at position 98 Thr or Gln; Xaa at position 102 is Lys, Val, Trp or Ser; Xaa at position 103 is Thr or Ser; Xaa at position 106 is Asn, Gln, or His; Xaa at position 109 is Ala or Glu; with the proviso that from four to forty-four of the amino acids designated by Xaa are different from the corresponding amino acids of native (1-133) human interleukin-3; and

(b) harvesting said cultured stem cells.

5. The method according to Claim 2 wherein said

interleukin-3 mutant polypeptide is selected from the group consisting of:

Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys  
 5 Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu Asn Ala  
 Glu Asp Val Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
 10 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
 (SEQ ID NO:66);

Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys  
 15 Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu Asn Ser  
 Glu Asp Met Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
 20 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
 (SEQ ID NO:67);

Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys  
 25 Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu Asn Ser  
 Glu Asp Met Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
 30 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
 (SEQ ID NO:68);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
 35 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
 Glu Asp Gln Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro  
 Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu Glu Asn  
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys

Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
 (SEQ ID NO:69);

5

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
 Glu Asp Gln Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro  
 Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu Glu Asn  
 10 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
 (SEQ ID NO:70);

15

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
 Glu Asp Gln Asp Ile Leu Met Glu Arg Asn Leu Arg Thr Pro  
 Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu Glu Asn  
 20 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
 (SEQ ID NO:71);

25

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
 30 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys  
 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile  
 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Arg Lys Leu Thr  
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
 (SEQ ID NO:72);

35

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro

Sequence Report

Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val Pro Cys  
Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Thr  
Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Arg Lys Leu Thr  
5 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
(SEQ ID NO:73);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
10 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Glu Lys Leu Thr  
15 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln  
(SEQ ID NO:74);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
20 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Glu Lys Leu Thr  
25 Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln Gln  
(SEQ ID NO:75);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
30 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys  
Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile  
Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr  
35 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln  
(SEQ ID NO:76);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys

```

20  Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
    Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu Asn Ala
    Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro
    Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu Glu Asn
    Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
25  Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
    Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
    Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
    (SEO ID NO:79);

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30  Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
    Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu Asn Ser
    Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg Thr Pro
    Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu Glu Asn
    Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
35  Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
    Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
    Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
    (SEQ ID NO:80);

```

Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys  
 Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu Asn Ser  
 Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro  
 5 Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu Glu Asn  
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln

10 (SEQ ID NO:81);

Met Ala Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His  
 Leu Lys Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu  
 Asn Gly Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg  
 15 Arg Pro Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu  
 Gln Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln

20 Gln (SEQ ID NO:82);

Met Ala Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His  
 Leu Lys Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu  
 Asn Gly Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg  
 25 Arg Pro Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu  
 Gln Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln

30 Gln (SEQ ID NO:83);

Met Ala Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His  
 Leu Lys Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu  
 Asn Gly Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg  
 35 Arg Pro Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu  
 Gln Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys

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5 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
  Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu
  Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg
  Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu
  Glu Asn Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu
  Pro Cys Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro
10 Ile His Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys
  Leu Thr Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln
  Gln (SEQ ID NO:85);

```

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25 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His
Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg
Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu
Glu Asn Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu
Pro Cys Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro
30 Ile His Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys
Leu Thr Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln
Gln (SEQ ID NO:87);

```

35 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg  
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln

Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
 Gln (SEQ ID NO:88);

5

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
 Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu  
 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
 Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu  
 10 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
 Gln (SEQ ID NO:89);

15

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
 Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu  
 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
 Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu  
 20 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
 Gln (SEQ ID NO:90);

25

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
 Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg  
 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
 30 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
 Gln (SEQ ID NO:91);

35

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
 Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu  
 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg

Protein Data Bank

Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu  
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 5 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
 Gln (SEQ ID NO:92);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
 Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu  
 10 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
 Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu  
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 15 Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln  
 Gln (SEQ ID NO:93);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
 Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu  
 20 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
 Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu  
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 25 Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln  
 Gln (SEQ ID NO:94);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
 Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu  
 30 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
 Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu  
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 35 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
 Gln (SEQ ID NO:95);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His

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	Leu	Lys	Arg	Pro	Pro	Ala	Pro	Leu	Leu	Asp	Pro	Asn	Asn	Leu
	Asn	Ala	Glu	Asp	Val	Asp	Ile	Leu	Met	Glu	Arg	Asn	Leu	Arg
	Leu	Pro	Asn	Leu	Glu	Ser	Phe	Val	Arg	Ala	Val	Lys	Asn	Leu
	Glu	Asn	Ala	Ser	Gly	Ile	Glu	Ala	Ile	Leu	Arg	Asn	Leu	Val
5	Pro	Cys	Leu	Pro	Ser	Ala	Thr	Ala	Ala	Pro	Ser	Arg	His	Pro
	Ile	Thr	Ile	Lys	Ala	Gly	Asp	Trp	Gln	Glu	Phe	Arg	Glu	Lys
	Leu	Thr	Phe	Tyr	Leu	Val	Ser	Leu	Glu	His	Ala	Gln	Glu	Gln
	Gln (SEQ ID NO:96);													
10	Met	Ala	Asn	Cys	Ser	Ile	Met	Ile	Asp	Glu	Ile	Ile	His	His
	Leu	Lys	Arg	Pro	Pro	Ala	Pro	Leu	Leu	Asp	Pro	Asn	Asn	Leu
	Asn	Ala	Glu	Asp	Val	Asp	Ile	Leu	Met	Asp	Arg	Asn	Leu	Arg
	Leu	Ser	Asn	Leu	Glu	Ser	Phe	Val	Arg	Ala	Val	Lys	Asn	Leu
	Glu	Asn	Ala	Ser	Gly	Ile	Glu	Ala	Ile	Leu	Arg	Asn	Leu	Gln
15	Pro	Cys	Leu	Pro	Ser	Ala	Thr	Ala	Ala	Pro	Ser	Arg	His	Pro
	Ile	Ile	Ile	Lys	Ala	Gly	Asp	Trp	Gln	Glu	Phe	Arg	Glu	Lys
	Leu	Thr	Phe	Tyr	Leu	Val	Thr	Leu	Glu	Gln	Ala	Gln	Glu	Gln
	Gln (SEQ ID NO:296);													
20	Met	Ala	Asn	Cys	Ser	Ile	Met	Ile	Asp	Glu	Ala	Ile	His	His
	Leu	Lys	Arg	Pro	Pro	Ala	Pro	Ser	Leu	Asp	Pro	Asn	Asn	Leu
	Asn	Asp	Glu	Asp	Met	Ser	Ile	Leu	Met	Glu	Arg	Asn	Leu	Arg
	Leu	Pro	Asn	Leu	Glu	Ser	Phe	Val	Arg	Ala	Val	Lys	Asn	Leu
	Glu	Asn	Ala	Ser	Gly	Ile	Glu	Ala	Ile	Leu	Arg	Asn	Leu	Gln
25	Pro	Cys	Leu	Pro	Ser	Ala	Thr	Ala	Ala	Pro	Ser	Arg	His	Pro
	Ile	Ile	Ile	Lys	Ala	Gly	Asp	Trp	Gln	Glu	Phe	Arg	Glu	Lys
	Leu	Thr	Phe	Tyr	Leu	Val	Thr	Leu	Glu	Gln	Ala	Gln	Glu	Gln
	Gln (SEQ ID NO:300);													
30	Met	Ala	Asn	Cys	Ser	Ile	Met	Ile	Asp	Glu	Ile	Ile	His	His
	Leu	Lys	Arg	Pro	Pro	Ala	Pro	Leu	Leu	Asp	Pro	Asn	Asn	Leu
	Asn	Asp	Glu	Asp	Met	Ser	Ile	Leu	Met	Glu	Arg	Asn	Leu	Arg
	Leu	Pro	Asn	Leu	Glu	Ser	Phe	Val	Arg	Ala	Val	Lys	Asn	Leu
	Glu	Asn	Ala	Ser	Gly	Ile	Glu	Ala	Ile	Leu	Arg	Asn	Leu	Gln
35	Pro	Cys	Leu	Pro	Ser	Ala	Thr	Ala	Ala	Pro	Ser	Arg	His	Pro
	Ile	Ile	Ile	Lys	Ala	Gly	Asp	Trp	Gln	Glu	Phe	Arg	Glu	Lys
	Leu	Thr	Phe	Tyr	Leu	Val	Thr	Leu	Glu	Gln	Ala	Gln	Glu	Gln
	Gln (SEQ ID NO:301);													

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
Asn Ala Glu Asp Val Asp Ile Leu Met Asp Arg Asn Leu Arg  
5 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
10 Gln (SEQ ID NO:308);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
Asn Asp Glu Asp Val Ser Ile Leu Met Glu Arg Asn Leu Arg  
15 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
20 Gln (SEQ ID NO:309);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
Asn Asp Glu Asp Met Ser Ile Leu Met Glu Arg Asn Leu Arg  
25 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
30 Gln (SEQ ID NO:310);

Met Ala Tyr Pro Glu Thr Asp Tyr Lys Asp Asp Asp Asp Lys  
Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys  
Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu Asn Ala  
35 Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro  
Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu Glu Asn  
Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys  
Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile

"seq" format



the stem cells having CD34 surface antigen.

9. Cultured stem cells obtained by the method of claim 1, 2, 3, 4, 5, 6, 7, or 8.

5

10. A method of human gene therapy, comprising the steps of;

(a) culturing stem cells with a selected growth medium comprising a human interleukin-3 mutant polypeptide of (SEQ ID NO:15);

wherein Xaa at position 17 is Ser, Lys, Gly, Asp, Met, Gln, or Arg;

- 15 Xaa at position 18 is Asn, His, Leu, Ile, Phe, Arg, or Gln;  
Xaa at position 19 is Met, Phe, Ile, Arg, Gly, Ala, or Cys;  
Xaa at position 20 is Ile, Cys, Gln, Glu, Arg, Pro, or Ala;  
Xaa at position 21 is Asp, Phe, Lys, Arg, Ala, Gly, Glu, Gln, Asn, Thr, Ser or Val;
- 20 Xaa at position 22 is Glu, Trp, Pro, Ser, Ala, His, Asp, Asn, Gln, Leu, Val or Gly;  
Xaa at position 23 is Ile, Val, Ala, Leu, Gly, Trp, Lys, Phe, Ser, or Arg;  
Xaa at position 24 is Ile, Gly, Val, Arg, Ser, Phe, or Leu;
- 25 Xaa at position 25 is Thr, His, Gly, Gln, Arg, Pro, or Ala;  
Xaa at position 26 is His, Thr, Phe, Gly, Arg, Ala, or Trp;  
Xaa at position 27 is Leu, Gly, Arg, Thr, Ser, or Ala;  
Xaa at position 28 is Lys, Arg, Leu, Gln, Gly, Pro, Val or Trp;  
Xaa at position 29 is Gln, Asn, Leu, Pro, Arg, or Val;
- 30 Xaa at position 30 is Pro, His, Thr, Gly, Asp, Gln, Ser, Leu, or Lys;  
Xaa at position 31 is Pro, Asp, Gly, Ala, Arg, Leu, or Gln;  
Xaa at position 32 is Leu, Val, Arg, Gln, Asn, Gly, Ala, or Glu;  
Xaa at position 33 is Pro, Leu, Gln, Ala, Thr, or Glu;
- 35 Xaa at position 34 is Leu, Val, Gly, Ser, Lys, Glu, Gln, Thr, Arg, Ala, Phe, Ile or Met;  
Xaa at position 35 is Leu, Ala, Gly, Asn, Pro, Gln, or Val;  
Xaa at position 36 is Asp, Leu, or Val;

- Xaa at position 37 is Phe, Ser, Pro, Trp, or Ile;  
 Xaa at position 38 is Asn, or Ala;  
 Xaa at position 40 is Leu, Trp, or Arg;  
 Xaa at position 41 is Asn, Cys, Arg, Leu, His, Met, or Pro;  
 5 Xaa at position 42 is Gly, Asp, Ser, Cys, Asn, Lys, Thr, Leu, Val,  
     Glu, Phe, Tyr, Ile, Met or Ala;  
 Xaa at position 43 is Glu, Asn, Tyr, Leu, Phe, Asp, Ala, Cys, Gln,  
     Arg, Thr, Gly or Ser;  
 Xaa at position 44 is Asp, Ser, Leu, Arg, Lys, Thr, Met, Trp, Glu,  
 10 Asn, Gln, Ala or Pro;  
 Xaa at position 45 is Gln, Pro, Phe, Val, Met, Leu, Thr, Lys, Trp,  
     Asp, Asn, Arg, Ser, Ala, Ile, Glu or His;  
 Xaa at position 46 is Asp, Phe, Ser, Thr, Cys, Glu, Asn, Gln, Lys,  
     His, Ala, Tyr, Ile, Val or Gly;  
 15 Xaa at position 47 is Ile, Gly, Val, Ser, Arg, Pro, or His;  
 Xaa at position 48 is Leu, Ser, Cys, Arg, Ile, His, Phe, Glu, Lys,  
     Thr, Ala, Met, Val or Asn;  
 Xaa at position 49 is Met, Arg, Ala, Gly, Pro, Asn, His, or Asp;  
 Xaa at position 50 is Glu, Leu, Thr, Asp, Tyr, Lys, Asn, Ser, Ala,  
 20 Ile, Val, His, Phe, Met or Gln;  
 Xaa at position 51 is Asn, Arg, Met, Pro, Ser, Thr, or His;  
 Xaa at position 52 is Asn, His, Arg, Leu, Gly, Ser, or Thr;  
 Xaa at position 53 is Leu, Thr, Ala, Gly, Glu, Pro, Lys, Ser, or  
     Met;  
 25 Xaa at position 54 is Arg, Asp, Ile, Ser, Val, Thr, Gln, Asn, Lys,  
     His, Ala or Leu;  
 Xaa at position 55 is Arg, Thr, Val, Ser, Leu, or Gly;  
 Xaa at position 56 is Pro, Gly, Cys, Ser, Gln, Glu, Arg, His,  
     Thr, Ala, Tyr, Phe, Leu, Val or Lys;  
 30 Xaa at position 57 is Asn or Gly;  
 Xaa at position 58 is Leu, Ser, Asp, Arg, Gln, Val, or Cys;  
 Xaa at position 59 is Glu, Tyr, His, Leu, Pro, or Arg;  
 Xaa at position 60 is Ala, Ser, Pro, Tyr, Asn, or Thr;  
 Xaa at position 61 is Phe, Asn, Glu, Pro, Lys, Arg, or Ser;  
 35 Xaa at position 62 is Asn, His, Val, Arg, Pro, Thr, Asp, or Ile;  
 Xaa at position 63 is Arg, Tyr, Trp, Lys, Ser, His, Pro, or Val;  
 Xaa at position 64 is Ala, Asn, Pro, Ser, or Lys;  
 Xaa at position 65 is Val, Thr, Pro, His, Leu, Phe, or Ser;

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- Xaa at position 66 is Lys, Ile, Arg, Val, Asn, Glu, or Ser;  
 Xaa at position 67 is Ser, Ala, Phe, Val, Gly, Asn, Ile, Pro, or His;  
 Xaa at position 68 is Leu, Val, Trp, Ser, Ile, Phe, Thr, or His;  
 5 Xaa at position 69 is Gln, Ala, Pro, Thr, Glu, Arg, Trp, Gly, or Leu;  
 Xaa at position 70 is Asn, Leu, Val, Trp, Pro, or Ala;  
 Xaa at position 71 is Ala, Met, Leu, Pro, Arg, Glu, Thr, Gln, Trp, or Asn;  
 10 Xaa at position 72 is Ser, Glu, Met, Ala, His, Asn, Arg, or Asp;  
 Xaa at position 73 is Ala, Glu, Asp, Leu, Ser, Gly, Thr, or Arg;  
 Xaa at position 74 is Ile, Met, Thr, Pro, Arg, Gly, Ala;  
 Xaa at position 75 is Glu, Lys, Gly, Asp, Pro, Trp, Arg, Ser, Gln, or Leu;  
 15 Xaa at position 76 is Ser, Val, Ala, Asn, Trp, Glu, Pro, Gly, or Asp;  
 Xaa at position 77 is Ile, Ser, Arg, Thr, or Leu;  
 Xaa at position 78 is Leu, Ala, Ser, Glu, Phe, Gly, or Arg;  
 Xaa at position 79 is Lys, Thr, Asn, Met, Arg, Ile, Gly, or Asp;  
 20 Xaa at position 80 is Asn, Trp, Val, Gly, Thr, Leu, Glu, or Arg;  
 Xaa at position 81 is Leu, Gln, Gly, Ala, Trp, Arg, Val, or Lys;  
 Xaa at position 82 is Leu, Gln, Lys, Trp, Arg, Asp, Glu, Asn, His, Thr, Ser, Ala, Tyr, Phe, Ile, Met or Val;  
 25 Xaa at position 83 is Pro, Ala, Thr, Trp, Arg, or Met;  
 Xaa at position 84 is Cys, Glu, Gly, Arg, Met, or Val;  
 Xaa at position 85 is Leu, Asn, Val, or Gln;  
 Xaa at position 86 is Pro, Cys, Arg, Ala, or Lys;  
 Xaa at position 87 is Leu, Ser, Trp, or Gly;  
 30 Xaa at position 88 is Ala, Lys, Arg, Val, or Trp;  
 Xaa at position 89 is Thr, Asp, Cys, Leu, Val, Glu, His, Asn, or Ser;  
 Xaa at position 90 is Ala, Pro, Ser, Thr, Gly, Asp, Ile, or Met;  
 Xaa at position 91 is Ala, Pro, Ser, Thr, Phe, Leu, Asp, or His;  
 35 Xaa at position 92 is Pro, Phe, Arg, Ser, Lys, His, Ala, Gly, Ile or Leu;  
 Xaa at position 93 is Thr, Asp, Ser, Asn, Pro, Ala, Leu, or Arg;  
 Xaa at position 94 is Arg, Ile, Ser, Glu, Leu, Val, Gln, Lys, His,

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- Ala, or Pro;
- Xaa at position 95 is His, Gln, Pro, Arg, Val, Leu, Gly, Thr, Asn,  
Lys, Ser, Ala, Trp, Phe, Ile, or Tyr;
- Xaa at position 96 is Pro, Lys, Tyr, Gly, Ile, or Thr;
- 5 Xaa at position 97 is Ile, Val, Lys, Ala, or Asn;
- Xaa at position 98 is His, Ile, Asn, Leu, Asp, Ala, Thr,  
Glu, Gln, Ser, Phe, Met, Val, Lys, Arg, Tyr or Pro;
- Xaa at position 99 is Ile, Leu, Arg, Asp, Val, Pro, Gln,  
Gly, Ser, Phe, or His;
- 10 Xaa at position 100 is Lys, Tyr, Leu, His, Arg, Ile, Ser, Gln,  
or Pro;
- Xaa at position 101 is Asp, Pro, Met, Lys, His, Thr, Val,  
Tyr, Glu, Asn, Ser, Ala, Gly, Ile, Leu, or Gln;
- Xaa at position 102 is Gly, Leu, Glu, Lys, Ser, Tyr, or Pro;
- 15 Xaa at position 103 is Asp, or Ser;
- Xaa at position 104 is Trp, Val, Cys, Tyr, Thr, Met, Pro, Leu,  
Gln, Lys, Ala, Phe, or Gly;
- Xaa at position 105 is Asn, Pro, Ala, Phe, Ser, Trp, Gln, Tyr,  
Leu, Lys, Ile, Asp, or His;
- 20 Xaa at position 106 is Glu, Ser, Ala, Lys, Thr, Ile, Gly, or Pro;
- Xaa at position 108 is Arg, Lys, Asp, Leu, Thr, Ile, Gln, His, Ser,  
Ala or Pro;
- Xaa at position 109 is Arg, Thr, Pro, Glu, Tyr, Leu, Ser, or Gly;
- Xaa at position 110 is Lys, Ala, Asn, Thr, Leu, Arg, Gln, His, Glu,  
Ser, or Trp;
- 25 Xaa at position 111 is Leu, Ile, Arg, Asp, or Met;
- Xaa at position 112 is Thr, Val, Gln, Tyr, Glu, His, Ser, or Phe;
- Xaa at position 113 is Phe, Ser, Cys, His, Gly, Trp, Tyr, Asp,  
Lys, Leu, Ile, Val or Asn;
- 30 Xaa at position 114 is Tyr, Cys, His, Ser, Trp, Arg, or Leu;
- Xaa at position 115 is Leu, Asn, Val, Pro, Arg, Ala, His, Thr,  
Trp, or Met;
- Xaa at position 116 is Lys, Leu, Pro, Thr, Met, Asp, Val, Glu,  
Arg, Trp, Ser, Asn, His, Ala, Tyr, Phe, Gln, or Ile;
- 35 Xaa at position 117 is Thr, Ser, Asn, Ile, Trp, Lys, or Pro;
- Xaa at position 118 is Leu, Ser, Pro, Ala, Glu, Cys, Asp, or Tyr;
- Xaa at position 119 is Glu, Ser, Lys, Pro, Leu, Thr, Tyr, or Arg;
- Xaa at position 120 is Asn, Ala, Pro, Leu, His, Val, or Gln;

Xaa at position 121 is Ala, Ser, Ile, Asn, Pro, Lys, Asp, or Gly;

Xaa at position 122 is Gln, Ser, Met, Trp, Arg, Phe, Pro, His, Ile, Tyr, or Cys;

5 Xaa at position 123 is Ala, Met, Glu, His, Ser, Pro, Tyr, or Leu;

wherein from 4 to 44 of the amino acids designated by Xaa are different from the corresponding amino acids of native (1-133) human interleukin-3; wherein from 1 to  
10 14 amino acids can be deleted from the N-terminus and/or from 1 to 15 amino acids can be deleted from the C-terminus of said interleukin-3 mutant polypeptide; and said interleukin-3 mutant polypeptide can additionally be immediately preceded by Methionine<sup>-1</sup>,  
15 Alanine<sup>-1</sup> or Methionine<sup>-2</sup> Alanine<sup>-1</sup>; and

(b) transducing DNA into said cultured cells;  
(c) harvesting said transduced cells; and  
(d) transplanting said transduced cells into said  
20 patient.

11. A method of human gene therapy, comprising the steps of;

25 (a) culturing stem cells with a selected growth medium comprising a human interleukin-3 mutant polypeptide of [SEQ ID NO:19];

wherein

30 Xaa at position 3 is Ser, Lys, Gly, Asp, Met, Gln, or Arg;  
Xaa at position 4 is Asn, His, Leu, Ile, Phe, Arg, or Gln;  
Xaa at position 5 is Met, Phe, Ile, Arg, Gly, Ala, or Cys;  
Xaa at position 6 is Ile, Cys, Gln, Glu, Arg, Pro, or Ala;  
Xaa at position 7 is Asp, Phe, Lys, Arg, Ala, Gly, Glu, Gln, Asn,  
35 Thr, Ser or Val;  
Xaa at position 8 is Glu, Trp, Pro, Ser, Ala, His, Asp, Asn, Gln, Leu, Val, or Gly;  
Xaa at position 9 is Ile, Val, Ala, Leu, Gly, Trp, Lys, Phe,

Ser, or Arg;

- Xaa at position 10 is Ile, Gly, Val, Arg, Ser, Phe, or Leu;  
 Xaa at position 11 is Thr, His, Gly, Gln, Arg, Pro, or Ala;  
 Xaa at position 12 is His, Thr, Phe, Gly, Arg, Ala, or Trp;  
 5 Xaa at position 13 is Leu, Gly, Arg, Thr, Ser, or Ala;  
 Xaa at position 14 is Lys, Arg, Leu, Gln, Gly, Pro, Val or Trp;  
 Xaa at position 15 is Gln, Asn, Leu, Pro, Arg, or Val;  
 Xaa at position 16 is Pro, His, Thr, Gly, Asp, Gln, Ser, Leu, or  
 Lys;  
 10 Xaa at position 17 is Pro, Asp, Gly, Ala, Arg, Leu, or Gln;  
 Xaa at position 18 is Leu, Val, Arg, Gln, Asn, Gly, Ala, or Glu;  
 Xaa at position 19 is Pro, Leu, Gln, Ala, Thr, or Glu;  
 Xaa at position 20 is Leu, Val, Gly, Ser, Lys, Glu, Gln, Thr,  
 Arg, Ala, Phe, Ile or Met;  
 15 Xaa at position 21 is Leu, Ala, Gly, Asn, Pro, Gln, or Val;  
 Xaa at position 22 is Asp, Leu, or Val;  
 Xaa at position 23 is Phe, Ser, Pro, Trp, or Ile;  
 Xaa at position 24 is Asn, or Ala;  
 Xaa at position 26 is Leu, Trp, or Arg;  
 20 Xaa at position 27 is Asn, Cys, Arg, Leu, His, Met, Pro;  
 Xaa at position 28 is Gly, Asp, Ser, Cys, Ala, Lys, Asn, Thr, Leu,  
 Val, Glu, Phe, Tyr, Ile or Met;  
 Xaa at position 29 is Glu, Asn, Tyr, Leu, Phe, Asp, Ala, Cys, Gln,  
 Arg, Thr, Gly or Ser;  
 25 Xaa at position 30 is Asp, Ser, Leu, Arg, Lys, Thr, Met, Trp, Glu,  
 Asn, Gln, Ala or Pro;  
 Xaa at position 31 is Gln, Pro, Phe, Val, Met, Leu, Thr, Lys, Asp,  
 Asn, Arg, Ser, Ala, Ile, Glu, His or Trp;  
 Xaa at position 32 is Asp, Phe, Ser, Thr, Cys, Glu, Asn, Gln,  
 30 Lys, His, Ala, Tyr, Ile, Val or Gly;  
 Xaa at position 33 is Ile, Gly, Val, Ser, Arg, Pro, or His;  
 Xaa at position 34 is Leu, Ser, Cys, Arg, Ile, His, Phe, Glu,  
 Lys, Thr, Ala, Met, Val or Asn;  
 Xaa at position 35 is Met, Arg, Ala, Gly, Pro, Asn, His, or Asp;  
 35 Xaa at position 36 is Glu, Leu, Thr, Asp, Tyr, Lys, Asn, Ser, Ala,  
 Ile, Val, His, Phe, Met or Gln;  
 Xaa at position 37 is Asn, Arg, Met, Pro, Ser, Thr, or His;  
 Xaa at position 38 is Asn, His, Arg, Leu, Gly, Ser, or Thr;

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- Xaa at position 39 is Leu, Thr, Ala, Gly, Glu, Pro, Lys, Ser,  
Met, or;
- Xaa at position 40 is Arg, Asp, Ile, Ser, Val, Thr, Gln, Asn,  
Lys, His, Ala or Leu;
- 5 Xaa at position 41 is Arg, Thr, Val, Ser, Leu, or Gly;  
Xaa at position 42 is Pro, Gly, Cys, Ser, Gln, Glu, Arg, His,  
Thr, Ala, Tyr, Phe, Leu, Val or Lys;  
Xaa at position 43 is Asn or Gly;  
Xaa at position 44 is Leu, Ser, Asp, Arg, Gln, Val, or Cys;
- 10 Xaa at position 45 is Glu, Tyr, His, Leu, Pro, or Arg;  
Xaa at position 46 is Ala, Ser, Pro, Tyr, Asn, or Thr;  
Xaa at position 47 is Phe, Asn, Glu, Pro, Lys, Arg, or Ser;  
Xaa at position 48 is Asn, His, Val, Arg, Pro, Thr, Asp, or Ile;  
Xaa at position 49 is Arg, Tyr, Trp, Lys, Ser, His, Pro, or Val;
- 15 Xaa at position 50 is Ala, Asn, Pro, Ser, or Lys;  
Xaa at position 51 is Val, Thr, Pro, His, Leu, Phe, or Ser;  
Xaa at position 52 is Lys, Ile, Arg, Val, Asn, Glu, or Ser;  
Xaa at position 53 is Ser, Ala, Phe, Val, Gly, Asn, Ile, Pro, or  
His;
- 20 Xaa at position 54 is Leu, Val, Trp, Ser, Ile, Phe, Thr, or His;  
Xaa at position 55 is Gln, Ala, Pro, Thr, Glu, Arg, Trp, Gly, or  
Leu;  
Xaa at position 56 is Asn, Leu, Val, Trp, Pro, or Ala;  
Xaa at position 57 is Ala, Met, Leu, Pro, Arg, Glu, Thr, Gln,  
Trp, or Asn;
- 25 Xaa at position 58 is Ser, Glu, Met, Ala, His, Asn, Arg, or Asp;  
Xaa at position 59 is Ala, Glu, Asp, Leu, Ser, Gly, Thr, or Arg;  
Xaa at position 60 is Ile, Met, Thr, Pro, Arg, Gly, Ala;  
Xaa at position 61 is Glu, Lys, Gly, Asp, Pro, Trp, Arg, Ser,  
Gln, or Leu;
- 30 Xaa at position 62 is Ser, Val, Ala, Asn, Trp, Glu, Pro, Gly, or  
Asp;  
Xaa at position 63 is Ile, Ser, Arg, Thr, or Leu;  
Xaa at position 64 is Leu, Ala, Ser, Glu, Phe, Gly, or Arg;
- 35 Xaa at position 65 is Lys, Thr, Gly, Asn, Met, Arg, Ile, or  
Asp;  
Xaa at position 66 is Asn, Trp, Val, Gly, Thr, Leu, Glu, or Arg;  
Xaa at position 67 is Leu, Gln, Gly, Ala, Trp, Arg, Val, or Lys;

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Xaa at position 68 is Leu, Gln, Lys, Trp, Arg, Asp, Glu, Asn,  
His, Thr, Ser, Ala, Tyr, Phe, Ile, Met or Val;  
Xaa at position 69 is Pro, Ala, Thr, Trp, Arg, or Met;  
Xaa at position 70 is Cys, Glu, Gly, Arg, Met, or Val;  
5 Xaa at position 71 is Leu, Asn, Val, or Gln;  
Xaa at position 72 is Pro, Cys, Arg, Ala, or Lys;  
Xaa at position 73 is Leu, Ser, Trp, or Gly;  
Xaa at position 74 is Ala, Lys, Arg, Val, or Trp;  
Xaa at position 75 is Thr, Asp, Cys, Leu, Val, Glu, His, Asn, or  
10 Ser;  
Xaa at position 76 is Ala, Pro, Ser, Thr, Gly, Asp, Ile, or Met;  
Xaa at position 77 is Ala, Pro, Ser, Thr, Phe, Leu, Asp, or His;  
Xaa at position 78 is Pro, Phe, Arg, Ser, Lys, His, Ala, Gly, Ile  
or Leu;  
15 Xaa at position 79 is Thr, Asp, Ser, Asn, Pro, Ala, Leu, or Arg;  
Xaa at position 80 is Arg, Ile, Ser, Glu, Leu, Val, Gln, Lys, His,  
Ala or Pro;  
Xaa at position 81 is His, Gln, Pro, Arg, Val, Leu, Gly, Thr, Asn,  
Lys, Ser, Ala, Trp, Phe, Ile or Tyr;  
20 Xaa at position 82 is Pro, Lys, Tyr, Gly, Ile, or Thr;  
Xaa at position 83 is Ile, Val, Lys, Ala, or Asn;  
Xaa at position 84 is His, Ile, Asn, Leu, Asp, Ala, Thr, Glu,  
Gln, Ser, Phe, Met, Val, Lys, Arg, Tyr or Pro;  
Xaa at position 85 is Ile, Leu, Arg, Asp, Val, Pro, Gln,  
25 Gly, Ser, Phe, or His;  
Xaa at position 86 is Lys, Tyr, Leu, His, Arg, Ile, Ser, Gln,  
Pro;  
Xaa at position 87 is Asp, Pro, Met, Lys, His, Thr, Val,  
Tyr, Glu, Asn, Ser, Ala, Gly, Ile, Leu or Gln;  
30 Xaa at position 88 is Gly, Leu, Glu, Lys, Ser, Tyr, or Pro;  
Xaa at position 89 is Asp, or Ser;  
Xaa at position 90 is Trp, Val, Cys, Tyr, Thr, Met, Pro, Leu,  
Gln, Lys, Ala, Phe, or Gly;  
Xaa at position 91 is Asn, Pro, Ala, Phe, Ser, Trp, Gln, Tyr,  
35 Leu, Lys, Ile, Asp, or His;  
Xaa at position 92 is Glu, Ser, Ala, Lys, Thr, Ile, Gly, or Pro;  
Xaa at position 94 is Arg, Lys, Asp, Leu, Thr, Ile, Gln,  
His, Ser, Ala, or Pro;

Xaa at position 95 is Arg, Thr, Pro, Glu, Tyr, Leu, Ser, or Gly;  
 Xaa at position 96 is Lys, Asn, Thr, Leu, Gln, Arg,

His, Glu, Ser, Ala or Trp;

Xaa at position 97 is Leu, Ile, Arg, Asp, or Met;

5 Xaa at position 98 is Thr, Val, Gln, Tyr, Glu, His, Ser, or Phe;

Xaa at position 99 is Phe, Ser, Cys, His, Gly, Trp, Tyr, Asp,

Lys, Leu, Ile, Val or Asn;

Xaa at position 100 is Tyr, Cys, His, Ser, Trp, Arg, or Leu;

Xaa at position 101 is Leu, Asn, Val, Pro, Arg, Ala, His, Thr,

10 Trp, or Met;

Xaa at position 102 is Lys, Leu, Pro, Thr, Met, Asp, Val, Glu, Arg,  
 Trp, Ser, Asn, His, Ala, Tyr, Phe, Gln, or Ile;

Xaa at position 103 is Thr, Ser, Asn, Ile, Trp, Lys, or Pro;

Xaa at position 104 is Leu, Ser, Pro, Ala, Glu, Cys, Asp, or Tyr;

15 Xaa at position 105 is Glu, Ser, Lys, Pro, Leu, Thr, Tyr, or Arg;

Xaa at position 106 is Asn, Ala, Pro, Leu, His, Val, or Gln;

Xaa at position 107 is Ala, Ser, Ile, Asn, Pro, Lys, Asp, or

Gly;

Xaa at position 108 is Gln, Ser, Met, Trp, Arg, Phe, Pro, His,

20 Ile, Tyr, or Cys;

Xaa at position 109 is Ala, Met, Glu, His, Ser, Pro, Tyr, or Leu;

wherein from 4 to 44 of the amino acids designated by  
 Xaa are different from the corresponding amino acids of  
 25 native (1-133) human interleukin-3; and said  
 interleukin-3 mutant polypeptide can additionally be  
 immediately preceded by Methionine<sup>-1</sup>, Alanine<sup>-1</sup> or  
 Methionine<sup>-2</sup> Alanine<sup>-1</sup>; and

30 (b) transducing DNA into said cultured cells;

(c) harvesting said transduced cells; and

(d) transplanting said transduced cells into said  
 patient.

35 12. A method of human gene therapy, comprising  
 the steps of;

(a) culturing stem cells with a selected growth

medium comprising a human interleukin-3 mutant polypeptide of (SEQ ID NO:129);

wherein m is 0 or 1; Xaa at position 18 is Asn or Ile;  
5 Xaa at position 19 is Met, Ala or Ile; Xaa at position 20 is Ile, Pro or Leu; Xaa at position 23 is Ile, Ala or Leu; Xaa at position 25 is Thr or His; Xaa at position 29 is Gln, Arg, Val or Leu; Xaa at position 32 is Leu, Ala, Asn or Arg; Xaa at position 34 is Leu or  
10 Ser; Xaa at position 37 is Phe, Pro, or Ser; Xaa at position 38 is Asn or Ala; Xaa at position 42 is Gly, Ala, Ser, Asp or Asn; Xaa at position 45 is Gln, Val, or Met; Xaa at position 46 is Asp or Ser; Xaa at position 49 is Met, Ile, Leu or Asp; Xaa at position 50  
15 is Glu or Asp; Xaa at position 51 is Asn Arg or Ser; Xaa at position 55 is Arg, Leu, or Thr; Xaa at position 56 is Pro or Ser; Xaa at position 59 is Glu or Leu; Xaa at position 60 is Ala or Ser; Xaa at position 62 is Asn, Val or Pro; Xaa at position 63 is Arg or His; Xaa  
20 at position 65 is Val or Ser; Xaa at position 67 is Ser, Asn, His or Gly; Xaa at position 69 is Gln or Glu; Xaa at position 73 is Ala or Gly; Xaa at position 76 is Ser, Ala or Pro; Xaa at position 79 is Lys, Arg or Ser; Xaa at position 82 is Leu, Glu, Val or Trp; Xaa at  
25 position 85 is Leu or Val; Xaa at position 87 is Leu, Ser, or Trp; Xaa at position 88 is Ala or Trp; Xaa at position 91 is Ala or Pro; Xaa at position 93 is Pro or Ser; Xaa at position 95 is His or Thr; Xaa at position 98 is His, Ile, or Thr; Xaa at position 100 is Lys or  
30 Arg; Xaa at position 101 is Asp, Ala or Met; Xaa at position 105 is Asn or Gln; Xaa at position 109 is Arg, Glu or Leu; Xaa at position 112 is Thr or Gln; Xaa at position 116 is Lys, Val, Trp or Ser; Xaa at position 117 is Thr or Ser; Xaa at position 120 is Asn, Gln, or  
35 His; Xaa at position 123 is Ala or Glu; with the proviso that from four to forty-four of the amino acids designated by Xaa are different from the corresponding amino acids of native human interleukin-3; and



- (b) transducing DNA into said cultured cells;
  - (c) harvesting said transduced cells; and
  - (d) transplanting said transduced cells into said
- 5 patient.

13. A method of human gene therapy, comprising the steps of;

10

(a) culturing stem cells with a selected growth medium comprising a human interleukin-3 mutant polypeptide of (SEQ ID NO:130);

15 wherein m is 0 or 1; n is 0 or 1; p is 0 or 1; Xaa at position 4 is Asn or Ile; Xaa at position 5 is Met, Ala or Ile; Xaa at position 6 is Ile, Pro or Leu; Xaa at position 9 is Ile, Ala or Leu; Xaa at position 11 is Thr or His; Xaa at position 15 is Gln, Arg, Val or Leu;

20 Xaa at position 18 is Leu, Ala, Asn or Arg; Xaa at position 20 is Leu or Ser; Xaa at position 23 is Phe, Pro, or Ser; Xaa at position 24 is Asn or Ala; Xaa at position 28 is Gly, Ala, Ser, Asp or Asn; Xaa at position 31 is Gln, Val, or Met; Xaa at position 32 is

25 Asp or Ser; Xaa at position 35 is Met, Ile, Leu or Asp; Xaa at position 36 is Glu or Asp; Xaa at position 37 is Asn, Arg or Ser; Xaa at position 41 is Arg, Leu, or Thr; Xaa at position 42 is Pro or Ser; Xaa at position 45 is Glu or Leu; Xaa at position 46 is Ala or Ser; Xaa

30 at position 48 is Asn, Val or Pro; Xaa at position 49 is Arg or His; Xaa at position 51 is Val or Ser; Xaa at position 53 is Ser, Asn, His or Gly; Xaa at position 55 is Gln or Glu; Xaa at position 59 is Ala or Gly; Xaa at position 62 is Ser, Ala or Pro; Xaa at position 65 is

35 Lys, Arg or Ser; Xaa at position 67 is Leu, Glu, or Val; Xaa at position 68 is Leu, Glu, Val or Trp; Xaa at position 71 is Leu or Val; Xaa at position 73 is Leu, Ser or Trp; Xaa at position 74 is Ala or Trp; Xaa

at position 77 is Ala or Pro; Xaa at position 79 is Pro or Ser; Xaa at position 81 is His or Thr; Xaa at position 84 is His, Ile, or Thr; Xaa at position 86 is Lys or Arg; Xaa at position 87 is Asp, Ala or Met; Xaa at position 91 is Asn or Gln; Xaa at position 95 is Arg, Glu, Leu; Xaa at position 98 Thr or Gln; Xaa at position 102 is Lys, Val, Trp or Ser; Xaa at position 103 is Thr or Ser; Xaa at position 106 is Asn, Gln, or His; Xaa at position 109 is Ala or Glu; with the proviso that from four to forty-four of the amino acids designated by Xaa are different from the corresponding amino acids of native (15-125)human interleukin-3; and

- (b) transducing DNA into said cultured cells;
- (c) harvesting said transduced cells; and
- (d) transplanting said transduced cells into said patient.

14. The method according to Claim 11 wherein said interleukin-3 mutant polypeptide is selected from the group consisting of:

Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys  
 Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu Asn Ala  
 Glu Asp Val Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
 (SEQ ID NO:66);

Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys  
 Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu Asn Ser  
 Glu Asp Met Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His

Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
(SEQ ID NO:67);

5 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys  
Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu Asn Ser  
Glu Asp Met Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
10 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
(SEQ ID NO:68);

15 Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
Glu Asp Gln Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro  
Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu Glu Asn  
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
20 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
(SEQ ID NO:69);

25 Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
Glu Asp Gln Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro  
Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu Glu Asn  
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
30 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
(SEQ ID NO:70);

35 Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
Glu Asp Gln Asp Ile Leu Met Glu Arg Asn Leu Arg Thr Pro  
Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu Glu Asn

Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln

5 (SEQ ID NO:71);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
10 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys  
Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile  
Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Arg Lys Leu Thr  
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln

15 (SEQ ID NO:72);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
20 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val Pro Cys  
Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Thr  
Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Arg Lys Leu Thr  
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln

25 (SEQ ID NO:73);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
30 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Glu Lys Leu Thr  
Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln

35 (SEQ ID NO:74);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly

Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
 5 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Glu Lys Leu Thr  
 Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln Gln  
 (SEQ ID NO:75);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
 10 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys  
 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile  
 15 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr  
 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln  
 (SEQ ID NO:76);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
 20 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val Pro Cys  
 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Thr  
 25 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr  
 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln  
 (SEQ ID NO:77);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
 30 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val Pro Cys  
 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Thr  
 35 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr  
 Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln Gln  
 (SEQ ID NO:78);

Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys  
Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu Asn Ala  
Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro  
Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu Glu Asn  
5 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
(SEQ ID NO:79);

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      Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
      Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu Asn Ser
      Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg Thr Pro
      Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu Glu Asn
15    Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
      Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
      Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
      Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
      (SEQ ID NO:80);

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      Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys
      Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu Asn Ser
      Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro
      Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu Glu Asn
25  Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys
      Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His
      Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr
      Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln
      (SEQ ID NO:81);

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	Met	Ala	Asn	Cys	Ser	Asn	Met	Ile	Asp	Glu	Ile	Ile	Thr	His
	Leu	Lys	Gln	Pro	Pro	Leu	Pro	Leu	Leu	Asp	Phe	Asn	Asn	Leu
	Asn	Gly	Glu	Asp	Gln	Asp	Ile	Leu	Met	Glu	Asn	Asn	Leu	Arg
	Arg	Pro	Asn	Leu	Glu	Ala	Phe	Asn	Arg	Ala	Val	Lys	Ser	Leu
35	Gln	Asn	Ala	Ser	Gly	Ile	Glu	Ala	Ile	Leu	Arg	Asn	Leu	Gln
	Pro	Cys	Leu	Pro	Ser	Ala	Thr	Ala	Ala	Pro	Ser	Arg	His	Pro
	Ile	Ile	Ile	Lys	Ala	Gly	Asp	Trp	Gln	Glu	Phe	Arg	Glu	Lys
	Leu	Thr	Phe	Tyr	Leu	Val	Thr	Leu	Glu	Gln	Ala	Gln	Glu	Gln

Gln (SEQ ID NO:82);

Met Ala Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His  
Leu Lys Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu  
5 Asn Gly Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg  
Arg Pro Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu  
Gln Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
10 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
Gln (SEQ ID NO:83);

Met Ala Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His  
Leu Lys Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu  
15 Asn Gly Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg  
Arg Pro Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu  
Gln Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
20 Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln  
Gln (SEQ ID NO:84);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
25 Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg  
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
Glu Asn Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu  
Pro Cys Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro  
Ile His Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys  
30 Leu Thr Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln  
Gln (SEQ ID NO:85);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu  
35 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu  
Glu Asn Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu  
Pro Cys Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro

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Ile His Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys  
Leu Thr Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln  
Gln (SEQ ID NO:86);

5 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu  
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu  
Glu Asn Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu  
10 Pro Cys Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro  
Ile His Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys  
Leu Thr Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln  
Gln (SEQ ID NO:87);

15 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg  
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
20 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
Gln (SEQ ID NO:88);

25 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu  
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu  
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
30 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
Gln (SEQ ID NO:89);

35 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu  
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu



Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
5 Gln (SEQ ID NO:90);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg  
10 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
15 Gln (SEQ ID NO:91);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu  
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
20 Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu  
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
25 Gln (SEQ ID NO:92);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu  
Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
30 Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu  
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln  
35 Gln (SEQ ID NO:93);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu

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Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
 Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu  
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 5 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln  
 Gln (SEQ ID NO:94);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
 10 Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu  
 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
 Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu  
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 15 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
 Gln (SEQ ID NO:95);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
 20 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
 Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg  
 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 25 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln  
 Gln (SEQ ID NO:96);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
 30 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
 Asn Ala Glu Asp Val Asp Ile Leu Met Asp Arg Asn Leu Arg  
 Leu Ser Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 35 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
 Gln (SEQ ID NO:296);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ala Ile His His  
Leu Lys Arg Pro Pro Ala Pro Ser Leu Asp Pro Asn Asn Leu  
Asn Asp Glu Asp Met Ser Ile Leu Met Glu Arg Asn Leu Arg  
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
5 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
Gln (SEQ ID NO:300);

10 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
Asn Asp Glu Asp Met Ser Ile Leu Met Glu Arg Asn Leu Arg  
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
15 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
Gln (SEQ ID NO:301);

20 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
Asn Ala Glu Asp Val Asp Ile Leu Met Asp Arg Asn Leu Arg  
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
25 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
Gln (SEQ ID NO:308);

30 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
Asn Asp Glu Asp Val Ser Ile Leu Met Glu Arg Asn Leu Arg  
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
35 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln

Gln (SEQ ID NO:309);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
 5 Asn Asp Glu Asp Met Ser Ile Leu Met Glu Arg Asn Leu Arg  
 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 10 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
 Gln (SEQ ID NO:310);

Met Ala Tyr Pro Glu Thr Asp Tyr Lys Asp Asp Asp Asp Lys  
 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys  
 15 Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu Asn Ala  
 Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro  
 Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu Glu Asn  
 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys  
 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile  
 20 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr  
 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln  
 (SEQ ID NO:315);

Met Ala Tyr Pro Glu Thr Asp Tyr Lys Asp Asp Asp Asp Lys  
 25 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys  
 Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu Asn Ser  
 Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg Thr Pro  
 Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu Glu Asn  
 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys  
 30 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile  
 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr  
 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln  
 (SEQ ID NO:316); and

35 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Leu Ile His His  
 Leu Lys Ile Pro Pro Asn Pro Ser Leu Asp Ser Ala Asn Leu  
 Asn Ser Glu Asp Val Ser Ile Leu Met Glu Arg Asn Leu Arg  
 Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu

Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
5 Gln (SEQ ID NO:318).

15. The method of claim 10 wherein said mutant  
human interleukin-3 polypeptide has at least three  
times greater activity than native human interleukin-3,  
10 in at least one assay selected from the group  
consisting of: AML cell proliferation, TF-1 cell  
proliferation and Methylcellulose assay.

16. The method of claim 10 further comprising the  
15 step of separating the stem cells from a mixed  
population of cells prior to culturing the stem cells.

17. The method of claim 16 wherein said stem  
cells are separated from a mixed population of cells  
20 based on the stem cells having CD34 surface antigen.

18. Transduced stem cells obtained by the method of claim  
10, 11, 12, 13, 14, 15, 16, or 17.

25 19. A method for treatment of a patient having a  
hematopoietic disorder, comprising the steps of;

(a) removing stem cells from said patient or  
a blood donor;

30 (b) culturing said stem cells with a selected  
growth medium comprising a human interleukin-3 mutant  
polypeptide of (SEQ ID NO:15);

wherein Xaa at position 17 is Ser, Lys, Gly, Asp, Met, Gln, or

35 Arg;

Xaa at position 18 is Asn, His, Leu, Ile, Phe, Arg, or Gln;

Xaa at position 19 is Met, Phe, Ile, Arg, Gly, Ala, or Cys;

Xaa at position 20 is Ile, Cys, Gln, Glu, Arg, Pro, or Ala;

- Xaa at position 21 is Asp, Phe, Lys, Arg, Ala, Gly, Glu, Gln, Asn, Thr, Ser or Val;
- Xaa at position 22 is Glu, Trp, Pro, Ser, Ala, His, Asp, Asn, Gln, Leu, Val or Gly;
- 5 Xaa at position 23 is Ile, Val, Ala, Leu, Gly, Trp, Lys, Phe, Ser, or Arg;
- Xaa at position 24 is Ile, Gly, Val, Arg, Ser, Phe, or Leu;
- Xaa at position 25 is Thr, His, Gly, Gln, Arg, Pro, or Ala;
- Xaa at position 26 is His, Thr, Phe, Gly, Arg, Ala, or Trp;
- 10 Xaa at position 27 is Leu, Gly, Arg, Thr, Ser, or Ala;
- Xaa at position 28 is Lys, Arg, Leu, Gln, Gly, Pro, Val or Trp;
- Xaa at position 29 is Gln, Asn, Leu, Pro, Arg, or Val;
- Xaa at position 30 is Pro, His, Thr, Gly, Asp, Gln, Ser, Leu, or Lys;
- 15 Xaa at position 31 is Pro, Asp, Gly, Ala, Arg, Leu, or Gln;
- Xaa at position 32 is Leu, Val, Arg, Gln, Asn, Gly, Ala, or Glu;
- Xaa at position 33 is Pro, Leu, Gln, Ala, Thr, or Glu;
- Xaa at position 34 is Leu, Val, Gly, Ser, Lys, Glu, Gln, Thr, Arg, Ala, Phe, Ile or Met;
- 20 Xaa at position 35 is Leu, Ala, Gly, Asn, Pro, Gln, or Val;
- Xaa at position 36 is Asp, Leu, or Val;
- Xaa at position 37 is Phe, Ser, Pro, Trp, or Ile;
- Xaa at position 38 is Asn, or Ala;
- Xaa at position 40 is Leu, Trp, or Arg;
- 25 Xaa at position 41 is Asn, Cys, Arg, Leu, His, Met, or Pro;
- Xaa at position 42 is Gly, Asp, Ser, Cys, Asn, Lys, Thr, Leu, Val, Glu, Phe, Tyr, Ile, Met or Ala;
- Xaa at position 43 is Glu, Asn, Tyr, Leu, Phe, Asp, Ala, Cys, Gln, Arg, Thr, Gly or Ser;
- 30 Xaa at position 44 is Asp, Ser, Leu, Arg, Lys, Thr, Met, Trp, Glu, Asn, Gln, Ala or Pro;
- Xaa at position 45 is Gln, Pro, Phe, Val, Met, Leu, Thr, Lys, Trp, Asp, Asn, Arg, Ser, Ala, Ile, Glu or His;
- Xaa at position 46 is Asp, Phe, Ser, Thr, Cys, Glu, Asn, Gln, Lys, His, Ala, Tyr, Ile, Val or Gly;
- 35 Xaa at position 47 is Ile, Gly, Val, Ser, Arg, Pro, or His;
- Xaa at position 48 is Leu, Ser, Cys, Arg, Ile, His, Phe, Glu, Lys, Thr, Ala, Met, Val or Asn;

- Xaa at position 49 is Met, Arg, Ala, Gly, Pro, Asn, His, or Asp;  
 Xaa at position 50 is Glu, Leu, Thr, Asp, Tyr, Lys, Asn, Ser, Ala, Ile, Val, His, Phe, Met or Gln;  
 Xaa at position 51 is Asn, Arg, Met, Pro, Ser, Thr, or His;
- 5 Xaa at position 52 is Asn, His, Arg, Leu, Gly, Ser, or Thr;  
 Xaa at position 53 is Leu, Thr, Ala, Gly, Glu, Pro, Lys, Ser, or Met;  
 Xaa at position 54 is Arg, Asp, Ile, Ser, Val, Thr, Gln, Asn, Lys, His, Ala or Leu;
- 10 Xaa at position 55 is Arg, Thr, Val, Ser, Leu, or Gly;  
 Xaa at position 56 is Pro, Gly, Cys, Ser, Gln, Glu, Arg, His, Thr, Ala, Tyr, Phe, Leu, Val or Lys;  
 Xaa at position 57 is Asn or Gly;  
 Xaa at position 58 is Leu, Ser, Asp, Arg, Gln, Val, or Cys;
- 15 Xaa at position 59 is Glu, Tyr, His, Leu, Pro, or Arg;  
 Xaa at position 60 is Ala, Ser, Pro, Tyr, Asn, or Thr;  
 Xaa at position 61 is Phe, Asn, Glu, Pro, Lys, Arg, or Ser;  
 Xaa at position 62 is Asn, His, Val, Arg, Pro, Thr, Asp, or Ile;  
 Xaa at position 63 is Arg, Tyr, Trp, Lys, Ser, His, Pro, or Val;
- 20 Xaa at position 64 is Ala, Asn, Pro, Ser, or Lys;  
 Xaa at position 65 is Val, Thr, Pro, His, Leu, Phe, or Ser;  
 Xaa at position 66 is Lys, Ile, Arg, Val, Asn, Glu, or Ser;  
 Xaa at position 67 is Ser, Ala, Phe, Val, Gly, Asn, Ile, Pro, or His;
- 25 Xaa at position 68 is Leu, Val, Trp, Ser, Ile, Phe, Thr, or His;  
 Xaa at position 69 is Gln, Ala, Pro, Thr, Glu, Arg, Trp, Gly, or Leu;  
 Xaa at position 70 is Asn, Leu, Val, Trp, Pro, or Ala;  
 Xaa at position 71 is Ala, Met, Leu, Pro, Arg, Glu, Thr, Gln, Trp, or Asn;
- 30 Xaa at position 72 is Ser, Glu, Met, Ala, His, Asn, Arg, or Asp;  
 Xaa at position 73 is Ala, Glu, Asp, Leu, Ser, Gly, Thr, or Arg;  
 Xaa at position 74 is Ile, Met, Thr, Pro, Arg, Gly, Ala;  
 Xaa at position 75 is Glu, Lys, Gly, Asp, Pro, Trp, Arg, Ser, Gln, or Leu;
- 35 Xaa at position 76 is Ser, Val, Ala, Asn, Trp, Glu, Pro, Gly, or Asp;  
 Xaa at position 77 is Ile, Ser, Arg, Thr, or Leu;

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Xaa at position 78 is Leu, Ala, Ser, Glu, Phe, Gly, or Arg;

Xaa at position 79 is Lys, Thr, Asn, Met, Arg, Ile, Gly, or

Asp;

Xaa at position 80 is Asn, Trp, Val, Gly, Thr, Leu, Glu, or Arg;

5 Xaa at position 81 is Leu, Gln, Gly, Ala, Trp, Arg, Val, or Lys;

Xaa at position 82 is Leu, Gln, Lys, Trp, Arg, Asp, Glu, Asn, His,

Thr, Ser, Ala, Tyr, Phe, Ile, Met or Val;

Xaa at position 83 is Pro, Ala, Thr, Trp, Arg, or Met;

Xaa at position 84 is Cys, Glu, Gly, Arg, Met, or Val;

10 Xaa at position 85 is Leu, Asn, Val, or Gln;

Xaa at position 86 is Pro, Cys, Arg, Ala, or Lys;

Xaa at position 87 is Leu, Ser, Trp, or Gly;

Xaa at position 88 is Ala, Lys, Arg, Val, or Trp;

Xaa at position 89 is Thr, Asp, Cys, Leu, Val, Glu, His, Asn, or

15 Ser;

Xaa at position 90 is Ala, Pro, Ser, Thr, Gly, Asp, Ile, or Met;

Xaa at position 91 is Ala, Pro, Ser, Thr, Phe, Leu, Asp, or His;

Xaa at position 92 is Pro, Phe, Arg, Ser, Lys, His, Ala, Gly, Ile  
or Leu;

20 Xaa at position 93 is Thr, Asp, Ser, Asn, Pro, Ala, Leu, or Arg;

Xaa at position 94 is Arg, Ile, Ser, Glu, Leu, Val, Gln, Lys, His,  
Ala, or Pro;

Xaa at position 95 is His, Gln, Pro, Arg, Val, Leu, Gly, Thr, Asn,  
Lys, Ser, Ala, Trp, Phe, Ile, or Tyr;

25 Xaa at position 96 is Pro, Lys, Tyr, Gly, Ile, or Thr;

Xaa at position 97 is Ile, Val, Lys, Ala, or Asn;

Xaa at position 98 is His, Ile, Asn, Leu, Asp, Ala, Thr,

Glu, Gln, Ser, Phe, Met, Val, Lys, Arg, Tyr or Pro;

Xaa at position 99 is Ile, Leu, Arg, Asp, Val, Pro, Gln,

30 Gly, Ser, Phe, or His;

Xaa at position 100 is Lys, Tyr, Leu, His, Arg, Ile, Ser, Gln,  
or Pro;

Xaa at position 101 is Asp, Pro, Met, Lys, His, Thr, Val,

Tyr, Glu, Asn, Ser, Ala, Gly, Ile, Leu, or Gln;

35 Xaa at position 102 is Gly, Leu, Glu, Lys, Ser, Tyr, or Pro;

Xaa at position 103 is Asp, or Ser;

Xaa at position 104 is Trp, Val, Cys, Tyr, Thr, Met, Pro, Leu,  
Gln, Lys, Ala, Phe, or Gly;



- Xaa at position 105 is Asn, Pro, Ala, Phe, Ser, Trp, Gln, Tyr,  
Leu, Lys, Ile, Asp, or His;
- Xaa at position 106 is Glu, Ser, Ala, Lys, Thr, Ile, Gly, or Pro;
- Xaa at position 108 is Arg, Lys, Asp, Leu, Thr, Ile, Gln, His, Ser,  
5 Ala or Pro;
- Xaa at position 109 is Arg, Thr, Pro, Glu, Tyr, Leu, Ser, or Gly;
- Xaa at position 110 is Lys, Ala, Asn, Thr, Leu, Arg, Gln, His, Glu,  
Ser, or Trp;
- Xaa at position 111 is Leu, Ile, Arg, Asp, or Met;
- 10 Xaa at position 112 is Thr, Val, Gln, Tyr, Glu, His, Ser, or Phe;
- Xaa at position 113 is Phe, Ser, Cys, His, Gly, Trp, Tyr, Asp,  
Lys, Leu, Ile, Val or Asn;
- Xaa at position 114 is Tyr, Cys, His, Ser, Trp, Arg, or Leu;
- Xaa at position 115 is Leu, Asn, Val, Pro, Arg, Ala, His, Thr,  
15 Trp, or Met;
- Xaa at position 116 is Lys, Leu, Pro, Thr, Met, Asp, Val, Glu,  
Arg, Trp, Ser, Asn, His, Ala, Tyr, Phe, Gln, or Ile;
- Xaa at position 117 is Thr, Ser, Asn, Ile, Trp, Lys, or Pro;
- Xaa at position 118 is Leu, Ser, Pro, Ala, Glu, Cys, Asp, or Tyr;
- 20 Xaa at position 119 is Glu, Ser, Lys, Pro, Leu, Thr, Tyr, or Arg;
- Xaa at position 120 is Asn, Ala, Pro, Leu, His, Val, or Gln;
- Xaa at position 121 is Ala, Ser, Ile, Asn, Pro, Lys, Asp, or  
Gly;
- Xaa at position 122 is Gln, Ser, Met, Trp, Arg, Phe, Pro, His,  
25 Ile, Tyr, or Cys;
- Xaa at position 123 is Ala, Met, Glu, His, Ser, Pro, Tyr, or Leu;

- wherein from 4 to 44 of the amino acids designated by  
Xaa are different from the corresponding amino acids of  
30 native (1-133) human interleukin-3; wherein from 1 to  
14 amino acids can be deleted from the N-terminus  
and/or from 1 to 15 amino acids can be deleted from the  
C-terminus of said interleukin-3 mutant polypeptide;  
and said interleukin-3 mutant polypeptide can  
35 additionally be immediately preceded by Methionine<sup>-1</sup>,  
Alanine<sup>-1</sup> or Methionine<sup>-2</sup> Alanine<sup>-1</sup>;

(c) harvesting said cultured stem cells; and

(d) transplanting said cultured stem cells into said patient.

20. A method for treatment of a patient having a  
5 hematopoietic disorder, comprising the steps of;

(a) removing stem cells from said patient or a blood donor;

(b) culturing said stem cells with a selected  
10 growth medium comprising a human interleukin-3 mutant polypeptide of (SEQ ID NO:19);

wherein

Xaa at position 3 is Ser, Lys, Gly, Asp, Met, Gln, or Arg;  
15 Xaa at position 4 is Asn, His, Leu, Ile, Phe, Arg, or Gln;  
Xaa at position 5 is Met, Phe, Ile, Arg, Gly, Ala, or Cys;  
Xaa at position 6 is Ile, Cys, Gln, Glu, Arg, Pro, or Ala;  
Xaa at position 7 is Asp, Phe, Lys, Arg, Ala, Gly, Glu, Gln, Asn,  
Thr, Ser or Val;  
20 Xaa at position 8 is Glu, Trp, Pro, Ser, Ala, His, Asp, Asn, Gln,  
Leu, Val, or Gly;  
Xaa at position 9 is Ile, Val, Ala, Leu, Gly, Trp, Lys, Phe,  
Ser, or Arg;  
Xaa at position 10 is Ile, Gly, Val, Arg, Ser, Phe, or Leu;  
25 Xaa at position 11 is Thr, His, Gly, Gln, Arg, Pro, or Ala;  
Xaa at position 12 is His, Thr, Phe, Gly, Arg, Ala, or Trp;  
Xaa at position 13 is Leu, Gly, Arg, Thr, Ser, or Ala;  
Xaa at position 14 is Lys, Arg, Leu, Gln, Gly, Pro, Val or Trp;  
Xaa at position 15 is Gln, Asn, Leu, Pro, Arg, or Val;  
30 Xaa at position 16 is Pro, His, Thr, Gly, Asp, Gln, Ser, Leu, or  
Lys;  
Xaa at position 17 is Pro, Asp, Gly, Ala, Arg, Leu, or Gln;  
Xaa at position 18 is Leu, Val, Arg, Gln, Asn, Gly, Ala, or Glu;  
Xaa at position 19 is Pro, Leu, Gln, Ala, Thr, or Glu;  
35 Xaa at position 20 is Leu, Val, Gly, Ser, Lys, Glu, Gln, Thr,  
Arg, Ala, Phe, Ile or Met;  
Xaa at position 21 is Leu, Ala, Gly, Asn, Pro, Gln, or Val;  
Xaa at position 22 is Asp, Leu, or Val;

- Xaa at position 23 is Phe, Ser, Pro, Trp, or Ile;  
 Xaa at position 24 is Asn, or Ala;  
 Xaa at position 26 is Leu, Trp, or Arg;  
 Xaa at position 27 is Asn, Cys, Arg, Leu, His, Met, Pro;  
 5 Xaa at position 28 is Gly, Asp, Ser, Cys, Ala, Lys, Asn, Thr, Leu,  
 Val, Glu, Phe, Tyr, Ile or Met;  
 Xaa at position 29 is Glu, Asn, Tyr, Leu, Phe, Asp, Ala, Cys, Gln,  
 Arg, Thr, Gly or Ser;  
 Xaa at position 30 is Asp, Ser, Leu, Arg, Lys, Thr, Met, Trp, Glu,  
 10 Asn, Gln, Ala or Pro;  
 Xaa at position 31 is Gln, Pro, Phe, Val, Met, Leu, Thr, Lys, Asp,  
 Asn, Arg, Ser, Ala, Ile, Glu, His or Trp;  
 Xaa at position 32 is Asp, Phe, Ser, Thr, Cys, Glu, Asn, Gln,  
 Lys, His, Ala, Tyr, Ile, Val or Gly;  
 15 Xaa at position 33 is Ile, Gly, Val, Ser, Arg, Pro, or His;  
 Xaa at position 34 is Leu, Ser, Cys, Arg, Ile, His, Phe, Glu,  
 Lys, Thr, Ala, Met, Val or Asn;  
 Xaa at position 35 is Met, Arg, Ala, Gly, Pro, Asn, His, or Asp;  
 Xaa at position 36 is Glu, Leu, Thr, Asp, Tyr, Lys, Asn, Ser, Ala,  
 20 Ile, Val, His, Phe, Met or Gln;  
 Xaa at position 37 is Asn, Arg, Met, Pro, Ser, Thr, or His;  
 Xaa at position 38 is Asn, His, Arg, Leu, Gly, Ser, or Thr;  
 Xaa at position 39 is Leu, Thr, Ala, Gly, Glu, Pro, Lys, Ser,  
 Met, or;  
 25 Xaa at position 40 is Arg, Asp, Ile, Ser, Val, Thr, Gln, Asn,  
 Lys, His, Ala or Leu;  
 Xaa at position 41 is Arg, Thr, Val, Ser, Leu, or Gly;  
 Xaa at position 42 is Pro, Gly, Cys, Ser, Gln, Glu, Arg, His,  
 Thr, Ala, Tyr, Phe, Leu, Val or Lys;  
 30 Xaa at position 43 is Asn or Gly;  
 Xaa at position 44 is Leu, Ser, Asp, Arg, Gln, Val, or Cys;  
 Xaa at position 45 is Glu, Tyr, His, Leu, Pro, or Arg;  
 Xaa at position 46 is Ala, Ser, Pro, Tyr, Asn, or Thr;  
 Xaa at position 47 is Phe, Asn, Glu, Pro, Lys, Arg, or Ser;  
 35 Xaa at position 48 is Asn, His, Val, Arg, Pro, Thr, Asp, or Ile;  
 Xaa at position 49 is Arg, Tyr, Trp, Lys, Ser, His, Pro, or Val;  
 Xaa at position 50 is Ala, Asn, Pro, Ser, or Lys;  
 Xaa at position 51 is Val, Thr, Pro, His, Leu, Phe, or Ser;

- Xaa at position 52 is Lys, Ile, Arg, Val, Asn, Glu, or Ser;  
Xaa at position 53 is Ser, Ala, Phe, Val, Gly, Asn, Ile, Pro, or His;  
Xaa at position 54 is Leu, Val, Trp, Ser, Ile, Phe, Thr, or His;  
5 Xaa at position 55 is Gln, Ala, Pro, Thr, Glu, Arg, Trp, Gly, or Leu;  
Xaa at position 56 is Asn, Leu, Val, Trp, Pro, or Ala;  
Xaa at position 57 is Ala, Met, Leu, Pro, Arg, Glu, Thr, Gln, Trp, or Asn;  
10 Xaa at position 58 is Ser, Glu, Met, Ala, His, Asn, Arg, or Asp;  
Xaa at position 59 is Ala, Glu, Asp, Leu, Ser, Gly, Thr, or Arg;  
Xaa at position 60 is Ile, Met, Thr, Pro, Arg, Gly, Ala;  
Xaa at position 61 is Glu, Lys, Gly, Asp, Pro, Trp, Arg, Ser, Gln, or Leu;  
15 Xaa at position 62 is Ser, Val, Ala, Asn, Trp, Glu, Pro, Gly, or Asp;  
Xaa at position 63 is Ile, Ser, Arg, Thr, or Leu;  
Xaa at position 64 is Leu, Ala, Ser, Glu, Phe, Gly, or Arg;  
Xaa at position 65 is Lys, Thr, Gly, Asn, Met, Arg, Ile, or Asp;  
20 Xaa at position 66 is Asn, Trp, Val, Gly, Thr, Leu, Glu, or Arg;  
Xaa at position 67 is Leu, Gln, Gly, Ala, Trp, Arg, Val, or Lys;  
Xaa at position 68 is Leu, Gln, Lys, Trp, Arg, Asp, Glu, Asn, His, Thr, Ser, Ala, Tyr, Phe, Ile, Met or Val;  
25 Xaa at position 69 is Pro, Ala, Thr, Trp, Arg, or Met;  
Xaa at position 70 is Cys, Glu, Gly, Arg, Met, or Val;  
Xaa at position 71 is Leu, Asn, Val, or Gln;  
Xaa at position 72 is Pro, Cys, Arg, Ala, or Lys;  
Xaa at position 73 is Leu, Ser, Trp, or Gly;  
30 Xaa at position 74 is Ala, Lys, Arg, Val, or Trp;  
Xaa at position 75 is Thr, Asp, Cys, Leu, Val, Glu, His, Asn, or Ser;  
Xaa at position 76 is Ala, Pro, Ser, Thr, Gly, Asp, Ile, or Met;  
Xaa at position 77 is Ala, Pro, Ser, Thr, Phe, Leu, Asp, or His;  
35 Xaa at position 78 is Pro, Phe, Arg, Ser, Lys, His, Ala, Gly, Ile or Leu;  
Xaa at position 79 is Thr, Asp, Ser, Asn, Pro, Ala, Leu, or Arg;  
Xaa at position 80 is Arg, Ile, Ser, Glu, Leu, Val, Gln, Lys, His,

- Ala or Pro;
- Xaa at position 81 is His, Gln, Pro, Arg, Val, Leu, Gly, Thr, Asn, Lys, Ser, Ala, Trp, Phe, Ile or Tyr;
- Xaa at position 82 is Pro, Lys, Tyr, Gly, Ile, or Thr;
- 5 Xaa at position 83 is Ile, Val, Lys, Ala, or Asn;
- Xaa at position 84 is His, Ile, Asn, Leu, Asp, Ala, Thr, Glu, Gln, Ser, Phe, Met, Val, Lys, Arg, Tyr or Pro;
- Xaa at position 85 is Ile, Leu, Arg, Asp, Val, Pro, Gln, Gly, Ser, Phe, or His;
- 10 Xaa at position 86 is Lys, Tyr, Leu, His, Arg, Ile, Ser, Gln, Pro;
- Xaa at position 87 is Asp, Pro, Met, Lys, His, Thr, Val, Tyr, Glu, Asn, Ser, Ala, Gly, Ile, Leu or Gln;
- Xaa at position 88 is Gly, Leu, Glu, Lys, Ser, Tyr, or Pro;
- 15 Xaa at position 89 is Asp, or Ser;
- Xaa at position 90 is Trp, Val, Cys, Tyr, Thr, Met, Pro, Leu, Gln, Lys, Ala, Phe, or Gly;
- Xaa at position 91 is Asn, Pro, Ala, Phe, Ser, Trp, Gln, Tyr, Leu, Lys, Ile, Asp, or His;
- 20 Xaa at position 92 is Glu, Ser, Ala, Lys, Thr, Ile, Gly, or Pro;
- Xaa at position 94 is Arg, Lys, Asp, Leu, Thr, Ile, Gln, His, Ser, Ala, or Pro;
- Xaa at position 95 is Arg, Thr, Pro, Glu, Tyr, Leu, Ser, or Gly;
- Xaa at position 96 is Lys, Asn, Thr, Leu, Gln, Arg, His, Glu, Ser, Ala or Trp;
- 25 Xaa at position 97 is Leu, Ile, Arg, Asp, or Met;
- Xaa at position 98 is Thr, Val, Gln, Tyr, Glu, His, Ser, or Phe;
- Xaa at position 99 is Phe, Ser, Cys, His, Gly, Trp, Tyr, Asp, Lys, Leu, Ile, Val or Asn;
- 30 Xaa at position 100 is Tyr, Cys, His, Ser, Trp, Arg, or Leu;
- Xaa at position 101 is Leu, Asn, Val, Pro, Arg, Ala, His, Thr, Trp, or Met;
- Xaa at position 102 is Lys, Leu, Pro, Thr, Met, Asp, Val, Glu, Arg, Trp, Ser,
- 35 Asn, His, Ala, Tyr, Phe, Gln, or Ile;
- Xaa at position 103 is Thr, Ser, Asn, Ile, Trp, Lys, or Pro;
- Xaa at position 104 is Leu, Ser, Pro, Ala, Glu, Cys, Asp, or Tyr;
- Xaa at position 105 is Glu, Ser, Lys, Pro, Leu, Thr, Tyr, or Arg;

Xaa at position 106 is Asn, Ala, Pro, Leu, His, Val, or Gln;

Xaa at position 107 is Ala, Ser, Ile, Asn, Pro, Lys, Asp, or  
Gly;

Xaa at position 108 is Gln, Ser, Met, Trp, Arg, Phe, Pro, His,

5 Ile, Tyr, or Cys;

Xaa at position 109 is Ala, Met, Glu, His, Ser, Pro, Tyr, or Leu;

wherein from 4 to 44 of the amino acids designated by  
Xaa are different from the corresponding amino acids of  
10 native (1-133) human interleukin-3; and said  
interleukin-3 mutant polypeptide can additionally be  
immediately preceded by Methionine<sup>-1</sup>, Alanine<sup>-1</sup> or  
Methionine<sup>-2</sup> Alanine<sup>-1</sup>;

15 (c) harvesting said cultured stem cells; and

(d) transplanting said cultured stem cells into  
said patient.

21. A method for treatment of a patient having a  
20 hematopoietic disorder, comprising the steps of;

(a) removing stem cells from said patient or  
a blood donor;

(b) culturing said stem cells with a selected  
25 growth medium comprising a human interleukin-3 mutant  
polypeptide of (SEQ ID NO:129);

wherein m is 0 or 1; Xaa at position 18 is Asn or Ile;  
Xaa at position 19 is Met, Ala or Ile; Xaa at position  
30 20 is Ile, Pro or Leu; Xaa at position 23 is Ile, Ala  
or Leu; Xaa at position 25 is Thr or His; Xaa at  
position 29 is Gln, Arg, Val or Leu; Xaa at position 32  
is Leu, Ala, Asn or Arg; Xaa at position 34 is Leu or  
Ser; Xaa at position 37 is Phe, Pro, or Ser; Xaa at  
35 position 38 is Asn or Ala; Xaa at position 42 is Gly,  
Ala, Ser, Asp or Asn; Xaa at position 45 is Gln, Val,  
or Met; Xaa at position 46 is Asp or Ser; Xaa at  
position 49 is Met, Ile, Leu or Asp; Xaa at position 50

is Glu or Asp; Xaa at position 51 is Asn Arg or Ser;  
 Xaa at position 55 is Arg, Leu, or Thr; Xaa at position  
 56 is Pro or Ser; Xaa at position 59 is Glu or Leu; Xaa  
 at position 60 is Ala or Ser; Xaa at position 62 is  
 5 Asn, Val or Pro; Xaa at position 63 is Arg or His; Xaa  
 at position 65 is Val or Ser; Xaa at position 67 is  
 Ser, Asn, His or Gly; Xaa at position 69 is Gln or Glu;  
 Xaa at position 73 is Ala or Gly; Xaa at position 76 is  
 Ser, Ala or Pro; Xaa at position 79 is Lys, Arg or Ser;  
 10 Xaa at position 82 is Leu, Glu, Val or Trp; Xaa at  
 position 85 is Leu or Val; Xaa at position 87 is Leu,  
 Ser, or Trp; Xaa at position 88 is Ala or Trp; Xaa at  
 position 91 is Ala or Pro; Xaa at position 93 is Pro or  
 Ser; Xaa at position 95 is His or Thr; Xaa at position  
 15 98 is His, Ile, or Thr; Xaa at position 100 is Lys or  
 Arg; Xaa at position 101 is Asp, Ala or Met; Xaa at  
 position 105 is Asn or Gln; Xaa at position 109 is Arg,  
 Glu or Leu; Xaa at position 112 is Thr or Gln; Xaa at  
 position 116 is Lys, Val, Trp or Ser; Xaa at position  
 20 117 is Thr or Ser; Xaa at position 120 is Asn, Gln, or  
 His; Xaa at position 123 is Ala or Glu; with the  
 proviso that from four to forty-four of the amino acids  
 designated by Xaa are different from the corresponding  
 amino acids of native human interleukin-3;

25

(c) harvesting said cultured stem cells; and

(d) transplanting said cultured stem cells into  
 said patient.

30

22. A method for treatment of a patient having a  
 hematopoietic disorder, comprising the steps of;

(a) removing stem cells from said patient or  
 35 a blood donor;

(b) culturing said stem cells with a selected  
 growth medium comprising a human interleukin-3 mutant  
 polypeptide of (SEQ ID NO:130);

wherein m is 0 or 1; n is 0 or 1; p is 0 or 1; Xaa at position 4 is Asn or Ile; Xaa at position 5 is Met, Ala or Ile; Xaa at position 6 is Ile, Pro or Leu; Xaa at position 9 is Ile, Ala or Leu; Xaa at position 11 is Thr or His; Xaa at position 15 is Gln, Arg, Val or Leu; Xaa at position 18 is Leu, Ala, Asn or Arg; Xaa at position 20 is Leu or Ser; Xaa at position 23 is Phe, Pro, or Ser; Xaa at position 24 is Asn or Ala; Xaa at position 28 is Gly, Ala, Ser, Asp or Asn; Xaa at position 31 is Gln, Val, or Met; Xaa at position 32 is Asp or Ser; Xaa at position 35 is Met, Ile, Leu or Asp; Xaa at position 36 is Glu or Asp; Xaa at position 37 is Asn, Arg or Ser; Xaa at position 41 is Arg, Leu, or Thr; Xaa at position 42 is Pro or Ser; Xaa at position 45 is Glu or Leu; Xaa at position 46 is Ala or Ser; Xaa at position 48 is Asn, Val or Pro; Xaa at position 49 is Arg or His; Xaa at position 51 is Val or Ser; Xaa at position 53 is Ser, Asn, His or Gly; Xaa at position 55 is Gln or Glu; Xaa at position 59 is Ala or Gly; Xaa at position 62 is Ser, Ala or Pro; Xaa at position 65 is Lys, Arg or Ser; Xaa at position 67 is Leu, Glu, or Val; Xaa at position 68 is Leu, Glu, Val or Trp; Xaa at position 71 is Leu or Val; Xaa at position 73 is Leu, Ser or Trp; Xaa at position 74 is Ala or Trp; Xaa at position 77 is Ala or Pro; Xaa at position 79 is Pro or Ser; Xaa at position 81 is His or Thr; Xaa at position 84 is His, Ile, or Thr; Xaa at position 86 is Lys or Arg; Xaa at position 87 is Asp, Ala or Met; Xaa at position 91 is Asn or Gln; Xaa at position 95 is Arg, Glu, Leu; Xaa at position 98 Thr or Gln; Xaa at position 102 is Lys, Val, Trp or Ser; Xaa at position 103 is Thr or Ser; Xaa at position 106 is Asn, Gln, or His; Xaa at position 109 is Ala or Glu; with the proviso that from four to forty-four of the amino acids designated by Xaa are different from the corresponding amino acids of native (15-125)human interleukin-3;



(c) harvesting said cultured stem cells; and  
(d) transplanting said cultured stem cells into  
said patient.

5           23. The method according to Claim 20 wherein said  
interleukin-3 mutant polypeptide is selected from the  
group consisting of:

10           Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys  
Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu Asn Ala  
Glu Asp Val Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
15           Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
(SEQ ID NO:66);

20           Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys  
Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu Asn Ser  
Glu Asp Met Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
25           Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
(SEQ ID NO:67);

30           Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys  
Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu Asn Ser  
Glu Asp Met Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
35           Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
(SEQ ID NO:68);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
 Glu Asp Gln Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro  
 Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu Glu Asn  
 5 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
 (SEQ ID NO:69);

10

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
 Glu Asp Gln Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro  
 Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu Glu Asn  
 15 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
 (SEQ ID NO:70);

20

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
 Glu Asp Gln Asp Ile Leu Met Glu Arg Asn Leu Arg Thr Pro  
 Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu Glu Asn  
 25 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
 (SEQ ID NO:71);

30

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
 Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
 Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
 35 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys  
 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile  
 Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Arg Lys Leu Thr  
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln

(SEQ ID NO:72);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
5 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val Pro Cys  
Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Thr  
Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Arg Lys Leu Thr  
10 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln

(SEQ ID NO:73);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
15 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Glu Lys Leu Thr  
20 Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln

(SEQ ID NO:74);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
25 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Glu Lys Leu Thr  
30 Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln Gln

(SEQ ID NO:75);

Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
35 Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys  
Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile

Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr  
Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln  
(SEQ ID NO:76);

5 Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val Pro Cys  
10 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Thr  
Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr  
Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln  
(SEQ ID NO:77);

15 Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His Leu Lys  
Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu Asn Gly  
Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg Arg Pro  
Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu Gln Asn  
Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val Pro Cys  
20 Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Thr  
Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr  
Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln Gln  
(SEQ ID NO:78);

25 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys  
Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu Asn Ala  
Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro  
Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu Glu Asn  
Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
30 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln  
(SEQ ID NO:79);

35 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys  
Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu Asn Ser  
Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg Thr Pro  
Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu Glu Asn

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Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln

5 (SEQ ID NO:80);

Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys  
 Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu Asn Ser  
 Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro  
 10 Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu Glu Asn  
 Ala Ser Ala Ile Glu Ser Ile Leu Lys Asn Leu Leu Pro Cys  
 Leu Pro Leu Ala Thr Ala Ala Pro Thr Arg His Pro Ile His  
 Ile Lys Asp Gly Asp Trp Asn Glu Phe Arg Arg Lys Leu Thr  
 Phe Tyr Leu Lys Thr Leu Glu Asn Ala Gln Ala Gln Gln

15 (SEQ ID NO:81);

Met Ala Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His  
 Leu Lys Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu  
 Asn Gly Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg  
 20 Arg Pro Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu  
 Gln Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln

25 Gln (SEQ ID NO:82);

Met Ala Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His  
 Leu Lys Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu  
 Asn Gly Glu Asp Gln Asp Ile Leu Met Glu Asn Asn Leu Arg  
 30 Arg Pro Asn Leu Glu Ala Phe Asn Arg Ala Val Lys Ser Leu  
 Gln Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln

35 Gln (SEQ ID NO:83);

Met Ala Asn Cys Ser Asn Met Ile Asp Glu Ile Ile Thr His  
 Leu Lys Gln Pro Pro Leu Pro Leu Leu Asp Phe Asn Asn Leu

	Asn	Gly	Glu	Asp	Gln	Asp	Ile	Leu	Met	Glu	Asn	Asn	Leu	Arg
	Arg	Pro	Asn	Leu	Glu	Ala	Phe	Asn	Arg	Ala	Val	Lys	Ser	Leu
	Gln	Asn	Ala	Ser	Gly	Ile	Glu	Ala	Ile	Leu	Arg	Asn	Leu	Val
	Pro	Cys	Leu	Pro	Ser	Ala	Thr	Ala	Ala	Pro	Ser	Arg	His	Pro
5	Ile	Thr	Ile	Lys	Ala	Gly	Asp	Trp	Gln	Glu	Phe	Arg	Glu	Lys
	Leu	Thr	Phe	Tyr	Leu	Val	Ser	Leu	Glu	His	Ala	Gln	Glu	Gln
	Gln (SEQ ID NO:84);													
	Met	Ala	Asn	Cys	Ser	Ile	Met	Ile	Asp	Glu	Ile	Ile	His	His
10	Leu	Lys	Arg	Pro	Pro	Ala	Pro	Leu	Leu	Asp	Pro	Asn	Asn	Leu
	Asn	Ala	Glu	Asp	Val	Asp	Ile	Leu	Met	Glu	Arg	Asn	Leu	Arg
	Leu	Pro	Asn	Leu	Glu	Ser	Phe	Val	Arg	Ala	Val	Lys	Asn	Leu
	Glu	Asn	Ala	Ser	Ala	Ile	Glu	Ser	Ile	Leu	Lys	Asn	Leu	Leu
	Pro	Cys	Leu	Pro	Leu	Ala	Thr	Ala	Ala	Pro	Thr	Arg	His	Pro
15	Ile	His	Ile	Lys	Asp	Gly	Asp	Trp	Asn	Glu	Phe	Arg	Arg	Lys
	Leu	Thr	Phe	Tyr	Leu	Lys	Thr	Leu	Glu	Asn	Ala	Gln	Ala	Gln
	Gln (SEQ ID NO:85);													
	Met	Ala	Asn	Cys	Ser	Ile	Met	Ile	Asp	Glu	Ile	Ile	His	His
20	Leu	Lys	Arg	Pro	Pro	Asn	Pro	Leu	Leu	Asp	Pro	Asn	Asn	Leu
	Asn	Ser	Glu	Asp	Met	Asp	Ile	Leu	Met	Glu	Arg	Asn	Leu	Arg
	Thr	Pro	Asn	Leu	Leu	Ala	Phe	Val	Arg	Ala	Val	Lys	His	Leu
	Glu	Asn	Ala	Ser	Ala	Ile	Glu	Ser	Ile	Leu	Lys	Asn	Leu	Leu
	Pro	Cys	Leu	Pro	Leu	Ala	Thr	Ala	Ala	Pro	Thr	Arg	His	Pro
25	Ile	His	Ile	Lys	Asp	Gly	Asp	Trp	Asn	Glu	Phe	Arg	Arg	Lys
	Leu	Thr	Phe	Tyr	Leu	Lys	Thr	Leu	Glu	Asn	Ala	Gln	Ala	Gln
	Gln (SEQ ID NO:86);													
	Met	Ala	Asn	Cys	Ser	Ile	Met	Ile	Asp	Glu	Ile	Ile	His	His
30	Leu	Lys	Val	Pro	Pro	Ala	Pro	Leu	Leu	Asp	Ser	Asn	Asn	Leu
	Asn	Ser	Glu	Asp	Met	Asp	Ile	Leu	Met	Glu	Arg	Asn	Leu	Arg
	Leu	Pro	Asn	Leu	Leu	Ala	Phe	Val	Arg	Ala	Val	Lys	Asn	Leu
	Glu	Asn	Ala	Ser	Ala	Ile	Glu	Ser	Ile	Leu	Lys	Asn	Leu	Leu
	Pro	Cys	Leu	Pro	Leu	Ala	Thr	Ala	Ala	Pro	Thr	Arg	His	Pro
35	Ile	His	Ile	Lys	Asp	Gly	Asp	Trp	Asn	Glu	Phe	Arg	Arg	Lys
	Leu	Thr	Phe	Tyr	Leu	Lys	Thr	Leu	Glu	Asn	Ala	Gln	Ala	Gln
	Gln (SEQ ID NO:87);													

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
 Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg  
 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
 5 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
 Gln (SEQ ID NO:88);

10

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
 Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu  
 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
 Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu  
 15 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
 Gln (SEQ ID NO:89);

20

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
 Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu  
 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
 Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu  
 25 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
 Gln (SEQ ID NO:90);

30

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
 Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg  
 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
 35 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln

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Gln (SEQ ID NO:91);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu  
5 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu  
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
10 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
Gln (SEQ ID NO:92);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu  
15 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu  
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
20 Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln  
Gln (SEQ ID NO:93);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Val Pro Pro Ala Pro Leu Leu Asp Ser Asn Asn Leu  
25 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
Leu Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys Asn Leu  
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
30 Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln  
Gln (SEQ ID NO:94);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu  
35 Asn Ser Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg  
Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu  
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro



Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
Gln (SEQ ID NO:95);

5 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
Asn Ala Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg  
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Val  
10 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Thr Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
Leu Thr Phe Tyr Leu Val Ser Leu Glu His Ala Gln Glu Gln  
Gln (SEQ ID NO:96);

15 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
Asn Ala Glu Asp Val Asp Ile Leu Met Asp Arg Asn Leu Arg  
Leu Ser Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
20 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
Gln (SEQ ID NO:296);

25 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ala Ile His His  
Leu Lys Arg Pro Pro Ala Pro Ser Leu Asp Pro Asn Asn Leu  
Asn Asp Glu Asp Met Ser Ile Leu Met Glu Arg Asn Leu Arg  
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
30 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
Gln (SEQ ID NO:300);

35 Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
Asn Asp Glu Asp Met Ser Ile Leu Met Glu Arg Asn Leu Arg  
Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu

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Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
 5 Gln (SEQ ID NO:301);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
 Asn Ala Glu Asp Val Asp Ile Leu Met Asp Arg Asn Leu Arg  
 10 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
 15 Gln (SEQ ID NO:308);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
 Asn Asp Glu Asp Val Ser Ile Leu Met Glu Arg Asn Leu Arg  
 20 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
 25 Gln (SEQ ID NO:309);

Met Ala Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His  
 Leu Lys Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu  
 Asn Asp Glu Asp Met Ser Ile Leu Met Glu Arg Asn Leu Arg  
 30 Leu Pro Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu  
 Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln  
 Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro  
 Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys  
 Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln  
 35 Gln (SEQ ID NO:310);

Met Ala Tyr Pro Glu Thr Asp Tyr Lys Asp Asp Asp Asp Lys  
 Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys

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    Arg Pro Pro Ala Pro Leu Leu Asp Pro Asn Asn Leu Asn Ala
    Glu Asp Val Asp Ile Leu Met Glu Arg Asn Leu Arg Leu Pro
    Asn Leu Glu Ser Phe Val Arg Ala Val Lys Asn Leu Glu Asn
    Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys
5  Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile
    Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr
    Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln
    (SEQ ID NO:315);

```

10 Met Ala Tyr Pro Glu Thr Asp Tyr Lys Asp Asp Asp Asp Lys  
Asn Cys Ser Ile Met Ile Asp Glu Ile Ile His His Leu Lys  
Arg Pro Pro Asn Pro Leu Leu Asp Pro Asn Asn Leu Asn Ser  
Glu Asp Met Asp Ile Leu Met Glu Arg Asn Leu Arg Thr Pro  
Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu Glu Asn  
15 Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln Pro Cys  
Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro Ile Ile  
Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys Leu Thr  
Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln Gln  
(SEQ ID NO:316); and

```

20      Met Ala Asn Cys Ser Ile Met Ile Asp Glu Leu Ile His His
      Leu Lys Ile Pro Pro Asn Pro Ser Leu Asp Ser Ala Asn Leu
      Asn Ser Glu Asp Val Ser Ile Leu Met Glu Arg Asn Leu Arg
      Thr Pro Asn Leu Leu Ala Phe Val Arg Ala Val Lys His Leu
25      Glu Asn Ala Ser Gly Ile Glu Ala Ile Leu Arg Asn Leu Gln
      Pro Cys Leu Pro Ser Ala Thr Ala Ala Pro Ser Arg His Pro
      Ile Ile Ile Lys Ala Gly Asp Trp Gln Glu Phe Arg Glu Lys
      Leu Thr Phe Tyr Leu Val Thr Leu Glu Gln Ala Gln Glu Gln
      Gln (SEQ ID NO:318).

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24. The method of claim 19 wherein said mutant human interleukin-3 polypeptide has at least three times greater activity than native human interleukin-3, in at least one assay selected from the group consisting of: AML cell proliferation, TF-1 cell proliferation and Methylcellulose assay.

25. The method of claim 19 further comprising the

step of separating the stem cells from a mixed population of cells prior to culturing the stem cells.

26. The method of claim 25 wherein said stem cells  
5 are separated from a mixed population of cells based on  
the stem cells having CD34 surface antigen.